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Development of the HH-60 Fuel Probe Container

403 SCMS/GUEB
AIR FORCE PACKAGING TECHNOLOGY & ENGINEERING FACILITY
WRIGHT PATTERSON AFB, OH 45433-5540
23 November 2009

NOTICE

AFPTEF PROJECT NO. 09-P-107
TITLE: Development of the HH-60 Fuel Probe Container

ABSTRACT

The Air Force Packaging Technology Engineering Facility (AFPTEF) was tasked with the design of a new shipping and storage container for the HH-60 Fuel Probe in April of 2009. The current wood container is difficult to handle, falls apart easily, provides minimal physical protection of the item, and offers no environmental protection against corrosion. To solve these issues AFPTEF used proven design techniques IAW SAE ARP1967A to develop an aluminum, long-life, controlled breathing, reusable shipping and storage container which will protect the fuel probe both mechanically and environmentally. The container passed all qualification tests per SAE ARP1967A, ASTM D4169, and MIL-STD-648.

This container not only meets user requirements but will also provide a significant economic savings, per refueling probe, for the Air Force over the twenty-year life span of the container.

Total man-hours: 475

PROJECT ENGINEER:

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INTRODUCTION

BACKGROUND – HH-60 personnel at Robins AFB (411 SCMS/GULD) contacted AFPTEF to request the design of a reusable container for the HH-60 Fuel Probe that would eliminate shipping and storage risks. The Fuel Probe is currently shipped in a wood box, which is difficult to handle and falls apart frequently. The box does not have environmental controls and is not sealed by the nature of its construction. These two factors allow the container to "breathe" with continuously changing environmental conditions. There is no means to control breathing or remove the excess moisture that results, which could cause a corrosion problem on the Probe.

REQUIREMENTS – AFPTEF developed a list of requirements based on the SPI and discussions with the customer. Many of these requirements were not met by the wood box. The requirements are as follows:

- Sealed/controlled-breathing container that protects against varied environmental conditions and weather during either inside or outside shipping and storage
- Reusable and designed for long life (20 years)
- Corrosion resistant container and hardware allow for extended storage outdoors
- Low maintenance
- Field replaceable hardware
- 2-way forklift capability
- Mechanical or hand lifting (4-6 people) of cover
- Probe shock/vibration limited to 110 Gs
- Clamp spacing similar to original container, will not interfere with wire harnesses
- Orient probe with extend/retract lines upward to avoid spillage of residual fuel
- Drip pan to catch residual fuel at forward end of probe
- No loose packing material
- End restraint to prevent forward/aft motion of the probe

DEVELOPMENT

DESIGN – The HH-60 Fuel Probe Shipping and Storage Container design meets all the users' requirements. The container is a sealed, welded aluminum, controlled breathing, reusable container (Appendix 2, Figure 1). The container is engineered for the physical and environmental protection of the Fuel Probe during worldwide transportation and storage. The container consists of a low-profile base and completely removable cover equipped with the special features listed below. The base is a double walled extrusion with 2-way forklift openings and a humidity indicator. A silicone rubber gasket and quick release cam-over-center latches create a water/air-tight seal at the base-cover interface. The cover is a double walled extrusion with a pressure equalizing valve (0.5 psi pressure/ 0.5 psi vacuum) and desiccant port for easy replacement of up to 48 units of desiccant (controls dehumidification). Container external dimensions are 179.5 inches

length, 25.0 inches width, and 22.4 inches height. Container empty weight is 548.5 pounds.

An aluminum cradle system is integrated into the base walls. The Probe is secured in the cradle by placing it into the HDPE-lined aluminum clamps (Appendix 2, Figures 2 & 3), inserting the alignment pin (Appendix 2, Figure 4) and then tightening the clamps (Appendix 2, Figure 5). There are no detachable parts on the container other than the container lid, which eliminates FOD risks.

HH-60 FUEL PROBE CONTAINER FEATURES	
Pressure Equalizing Valve	1
Humidity Indicator	1
Desiccant Port	1
Internal Document Receptacle	None
Forkliftable	Yes
Cover Latches	22
Cover Lift Handles	6
Cover Lift Rings	4
Cover Tether Rings	None
Base Lift Handles	None
Base Tie-down Rings	4
Stacking Capability	Yes

PROTOTYPE – AFPTEF fabricated one prototype container in house for testing. The prototype container was fabricated in accordance with (IAW) all requirements and tolerances of the container drawing package. The drawing package used for prototype fabrication has been released for the manufacture of production quantities of the container. Each face of the container was uniquely identified for testing identification as shown below.

DESIGNATED SIDE	**CONTAINER FEATURE**
Top	Cover Top
Aft	Desiccant Port
Right	Right Side from Aft
Left	Left Side from Aft
Forward	Opposite Aft
Bottom	Base Bottom

QUALIFICATION TESTING

TEST LOAD – The test load was a non-reparable HH-60 Fuel Probe, to which weights were added to ensure a correct test weight (Appendix 2, Figure 7). The primary triaxial

accelerometer used to record actual accelerations sustained by the Probe was mounted on the outer shell of the item. The test load weight was 156 pounds.

TEST PLAN – The test plan primary references were SAE ARP 1967, ASTM D 4169 and MIL-STD-648 (Appendix 1). The test methods specified in this test plan constituted the procedures for performing the tests on the container. The performance criteria for evaluation of container acceptability were specified at 110 Gs maximum and an initial and final leak rate of 0.25 psi per 30 minutes. These tests are commonly applied to special shipping containers providing rough handling protection to sensitive items. The tests were performed at AFPTEF, Building 70, Area C, Wright-Patterson AFB.

ITEM INSTRUMENTATION – The test load was instrumented with a piezoelectric triaxial accelerometer mounted on the outer shell of the Probe as close to the center of mass as possible (Appendix 2, Figure 6). Primary accelerometer axis orientations were as follows:

X Axis - Directed through container Left and Right sides.
Y Axis - Directed through container Forward and Aft (desiccant port) sides.
Z Axis - Directed through container Top and Bottom sides (Vertical motion).

See Appendix 4 for detailed accelerometer and other instrumentation information.

TEST SEQUENCES – Note: All test sequences were performed at ambient temperature and humidity, unless otherwise noted in the test procedure.

TEST SEQUENCE 1 – Leak Test

Procedure – The desiccant port cover was removed and replaced with a port cover modified for attachment of the digital manometer and vacuum/pressure pump lines. The container was closed and sealed. The leak test was conducted at ambient temperature and pressure. The pneumatic pressure leak technique was used to pressurize the container to a minimum test pressure of 1.5 psi. Maximum allowable leak rate is 0.025 psi per 30 minutes. (Appendix 2, Figure 8).

Results – The container passed the leak test with a leak rate less than the maximum allowed rate of 0.025 psi per 30 minutes.

TEST SEQUENCE 2 – Vacuum Retention Test

Procedure – The desiccant port cover was removed and replaced with a port cover modified for attachment of the digital manometer and vacuum/pressure pump lines. The container was closed and sealed. The vacuum retention test was conducted at ambient temperature and pressure. The air inside the container was evacuated to a minimum vacuum of -1.0 psi. Maximum allowable pressure increase rate is 0.025 psi per 30 minutes. (see Appendix 2, Figure 8).

Results – The container passed the vacuum retention test with a pressure increase rate less than the maximum allowed rate of 0.025 psi per 30 minutes.

TEST SEQUENCE 3 – Rotational Drops

Procedure – An Assurance Level I drop height of 12 inches was used to perform four corner and four edge drops onto a 1-inch thick steel plate, and the impact levels were recorded. The maximum allowed impact level for the item was 110 Gs. (Appendix 2, Figures 9 - 11)

Results – All of the recorded impact peak G data (unfiltered) was less than the maximum allowed 110 Gs. Unfiltered impact shock pulses were exaggerated by noise resulting from the hollow structure of the fuel probe. In addition, placement of the accelerometer on the probe was not ideal since the structure of the probe easily transmitted noise.

Because of this noise, each impact waveform was filtered at frequencies ranging from 93 Hz to 178 Hz as appropriate for each shock pulse, to permit truer analysis. The filter frequency for these complex shock pulses was conservatively calculated as 10 times the base frequency of the shock pulse. The filtered peak G data was at least 50% less than the unfiltered data for all but one waveform. Nothing in the shock pulses indicated unusual item behavior. There was no damage to either the container or the item. The container met the test requirements. (Appendix 3, Tables 1 & 3 and Waveforms.)

TEST SEQUENCE 4 – Lateral Impact (Pendulum Impact)

Procedure – The container was placed on the pendulum test apparatus and impacted once on the forward and aft sides (the left and right sides were too long for impact testing) . The container impact velocity was 7.3 ft/s. (Appendix 2, Figure 12)

Results – All of the recorded impact peak G data (unfiltered) was less than the maximum allowed 110 Gs. For the reasons stated in Test Sequence 3, this data was also filtered to remove as much extraneous noise as possible. After filtering, the forward impact was reduced by 17% and the aft impact by slightly more than 50%. There was no damage to either the container or the item. Nothing in the shock pulses indicated unusual item behavior. The container met the test requirements. (Appendix 3, Tables 1 & 3 and Waveforms.)

TEST SEQUENCE 5 – Vibration Test, Resonance Dwell

Procedure – The container was rigidly attached to the vibration platform. A sinusoidal vibration excitation was applied in the vertical direction and cyclically swept for 7.5 minutes at 2 minutes per octave to locate the resonant frequency. Input vibration from 5 to 12.5 Hz was at 0.125-inch double amplitude. Input vibration from 12.5 to 50.0 Hz was at 1.0 G (0 to peak). All signals were electronically filtered using a two-pole Butterworth filter with a 600 Hz cutoff frequency. The peak transmissibility values during the up and down frequency

sweeps were noted for use in determining the frequency search range for the resonance dwell test.

The vibration controller swept up the frequency range until the resonant frequency was reached. This frequency was manually tracked for a 30 minute resonance dwell test. The test was conducted at ambient temperature. (Appendix 2, Figure 13)

Results - The most significant resonant frequency of the packaged item occurred initially at 46.89 Hz, and increased during the dwell period to 49.44 Hz. By the end of the 30 minute test, the resonant frequency had decreased to 45.53 Hz. The maximum transmissibility throughout the test ranged between 4 and 5 (data filtered as described above at 434 Hz and 230 Hz), which is less than the design goal of 10 when the resonant frequency is between 25 and 50 Hz. All waveforms were filtered prior to analysis due to noise levels. At the end of the test period, there was no damage to the container or item. The container met the test requirements. (Appendix 3, Tables 2 & 4 and Waveforms)

TEST SEQUENCE 6 – Leak Test

Procedure – Test Sequence 1 was repeated.

Results – The container passed the leak test with a leak rate less than the maximum allowed rate of 0.025 psi per 30 minutes.

TEST SEQUENCE 7 – Vacuum Retention Test

Procedure – Test Sequence 2 was repeated.

Results – The container passed the vacuum retention test with a pressure increase rate less than the maximum allowed rate of 0.025 psi per 30 minutes.

TEST CONCLUSIONS – No damage occurred during the above testing to the final container design, isolation system or test item. All impact levels are at or below the item fragility limit of 110 Gs. Therefore, the container and mounting system do provide adequate protection for the fuel probe.

FIT & FUNCTION TESTING

Fit and function testing was completed on site at AFPTEF with the HH-60 fuel probe that was supplied for prototype testing.

CONCLUSIONS

No damage occurred during the above testing to the final container design, mounting system or test item. There was no evidence of any contact or impact between the fuel

probe and the container walls or lid. All impact levels are below the item fragility limit of 110 G's. The container met all the user's requirements. The container can protect the HH-60 Fuel Probe during world-wide transportation and storage and will save the Air Force tens of thousands of dollars in O&M costs.

RECOMMENDATIONS

AFPTEF recommends that new containers be procured and delivered to avoid damage to probes currently in the logistics cycle, thus mitigating overall shipping risks. All wood boxes for the probe should be replaced.

APPENDIX 1: Test Plan

AF PACKAGING TECHNOLOGY AND ENGINEERING FACILITY (Container Test Plan)					**AFPTEF PROJECT NUMBER:** 09-P-107	
CONTAINER SIZE (L x W x D) (IN) **INTERIOR:** 175.5 x 21.2 x 15.5	**EXTERIOR:** 179.5 x 25.0 x 22.4	**WEIGHT (LB)** **GROSS:** 704	**TARE:** 548	**CUBE (CU. FT)** 58.2	**QUANTITY:** 1	**DATE:** Aug 09
ITEM NAME: HH-60 Refueling Probe Assembly				**MANUFACTURER:** United Technologies Sikorsky Aircraft		
CONTAINER NAME: Reusable Shipping & Storage Container					**CONTAINER COST:** $	
PACK DESCRIPTION: Extruded Aluminum Container, Test Load of an HH-60 Refueling Probe						
CONDITIONING: Ambient Conditions						

TEST NO.	REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S	TEST TITLE AND PARAMETERS	CONTAINER ORIENTATION	EQUIPMENT & INSTRUMENTATION
		PASS/FAIL CRITERIA FOR ALL TESTS There shall be no damage, deformation or degradation of the packaging or components that would permit damage to contents, prevent installation of components, reduce container strength or cause stacking instability, permit water to enter, adversely affect safety during transport or storage, or interfere with container use. All components shall remain in place throughout testing.		
1.	**Product examination.** **SAE ARP 1967 Par. 4.5.1 Table I, Para. 4.5.8.3.7**	Container shall be weighed and carefully examined to determine conformance with material, workmanship, and requirements as specified in Table and drawings.	Shipping	Visual Inspection (VI), tape measure; Scale
2.	**Leak Check** **SAE ARP 1967 Para. 4.5.2.1**	Use pneumatic pressure of 1.5 psi and vacuum retention at -1.0 psi. After temperature stabilization, pressure drop shall not exceed 0.025 psi per 30 minutes. Perform leak test again at end of test series.	Shipping	Digital Manometer, Clock
3.	**Rotational Drops** **SAE ARP 1967 Para. 4.5.3 ASTM D 4169 ASTM D 6179 Methods A&B**	Drop height shall be 12". Item shall not sustain more than 110G's. Perform one drop on all bottom corners (4 drops) and one drop on all edges (4 drops).	Shipping	VI and Tri-axial Accelerometer, quick release, blocks, hoist

COMMENTS:

PREPARED BY:	**APPROVED BY:**
Michael R. Harff, Mechanical Engineer	Robbin L. Miller, Chief AFPTEF

AF PACKAGING TECHNOLOGY AND ENGINEERING FACILITY (Container Test Plan)					**AFPTEF PROJECT NUMBER:** 09-P-107	
CONTAINER SIZE (L x W x D) (IN) **INTERIOR:** 175.5 x 21.2 x 15.5	**EXTERIOR:** 179.5 x 25.0 x 22.4	**WEIGHT (LB)** **GROSS:** 704	**TARE:** 548	**CUBE (CU. FT)** 58.2	**QUANTITY:** 1	**DATE:** Aug 09
ITEM NAME: HH-60 Refueling Probe Assembly				**MANUFACTURER:** United Technologies Sikorsky Aircraft		
CONTAINER NAME: Reusable Shipping & Storage Container					**CONTAINER COST:** $	
PACK DESCRIPTION: Extruded Aluminum Container, Test Load of an HH-60 Refueling Probe						
CONDITIONING: Ambient Conditions						

TEST NO.	REF STD/SPEC AND TEST METHOD OR PROCEDURE NO'S	TEST TITLE AND PARAMETERS	CONTAINER ORIENTATION	EQUIPMENT & INSTRUMENTATION
4.	**Vibration** **SAE ARP 1967 Para. 4.5.6 (ASTM D 4169 ASTM D 999 Method B); MIL-STD-648D Para. 5.3.1 b and 5.3.3.1**	The container shall be vibrated from 5 Hz to 50 Hz at a sweep rate of one half octave per minute with a total sweep time of 7.5 minutes. Container shall then be vibrated for 30 minutes at the predominant resonance. Input excitation shall be 0.125 in double amplitude or 1 G limits.	Rigidly attach container to exciter.	VI and Tri-axial Accelerometer
5.	**Lateral Impact** **SAE ARP 1967 Para. 4.5.6 (ASTM D 4169 ASTM D 880 Procedure B); MIL-STD-648D, Para. 5.2.7**	Use impact velocity 7.3 ft/s. Item shall not sustain more than 110G's. Perform one impact on each end (2 impacts).	Shipping	VI and Tri-axial Accelerometer, quick release, winch
6.	**Leak Check** **SAE ARP 1967 Para. 4.5.2.1**	Use pneumatic pressure of 1.5 psi and vacuum retention at -1.0 psi. After temperature stabilization, pressure drop shall not exceed 0.025 psi per 30 minutes	Shipping	Digital Manometer, Clock

COMMENTS:

PREPARED BY: Michael R. Harff, Mechanical Engineer	**APPROVED BY:** Robbin L. Miller, Chief AFPTEF

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APPENDIX 2: Fabrication & Testing Photographs

Figure 1. Closed Container.

Figure 2. Probe in container base.

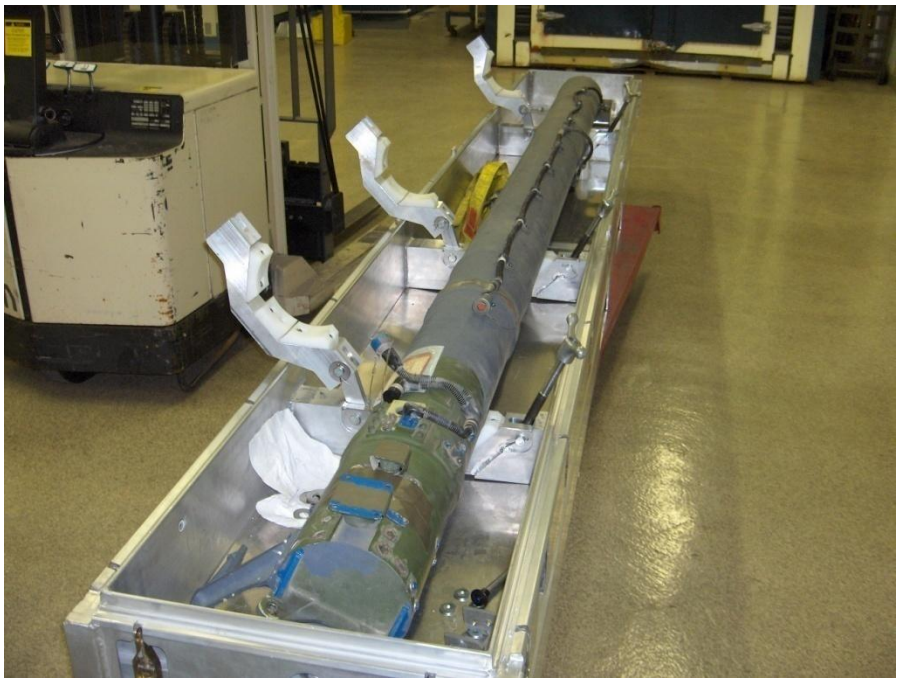


Figure 3. HDPE-Lined Clamps Open.

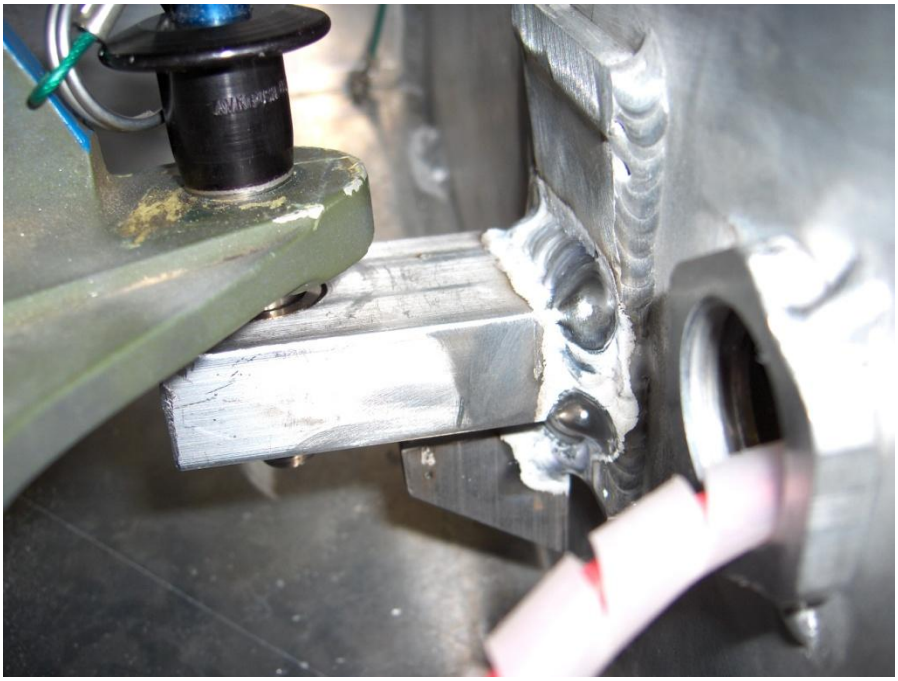


Figure 4. Aft Alignment Pin Secured.

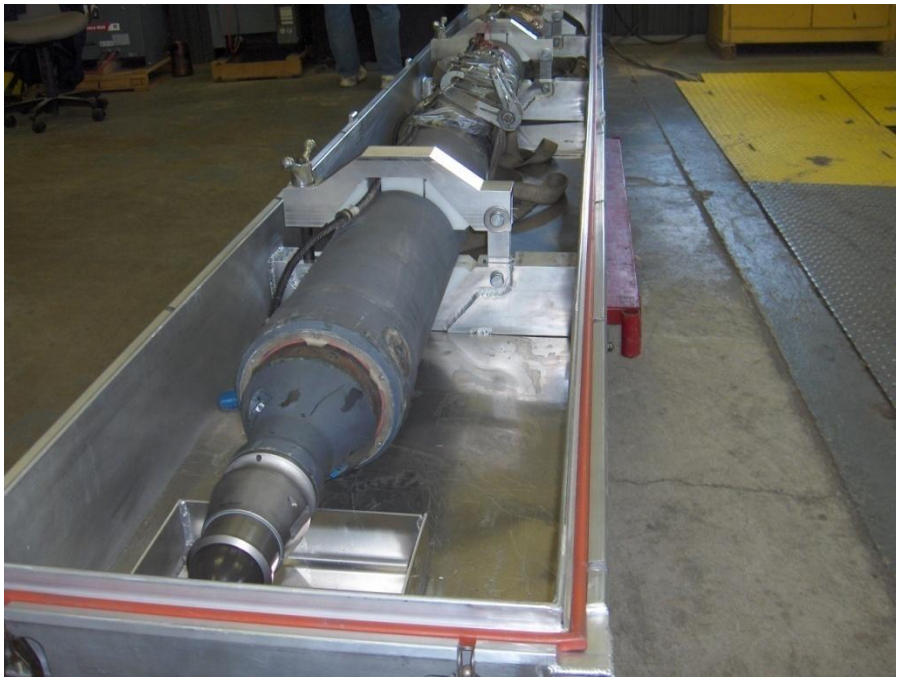


Figure 5. HDPE-Lined Clamps Closed.

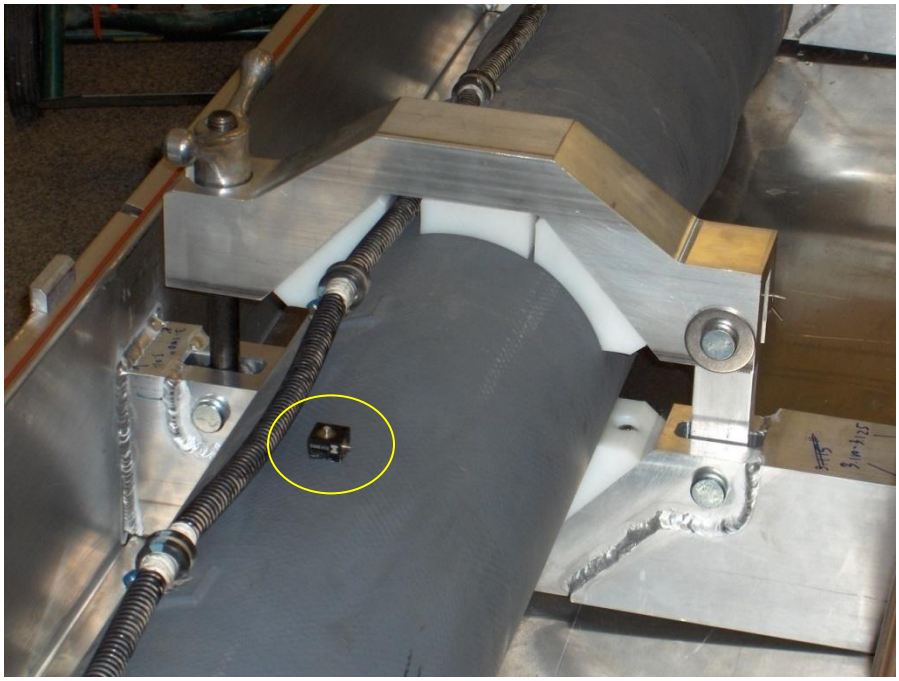


Figure 6. Placement of accelerometer on probe.

Figure 7. Weight added to probe.

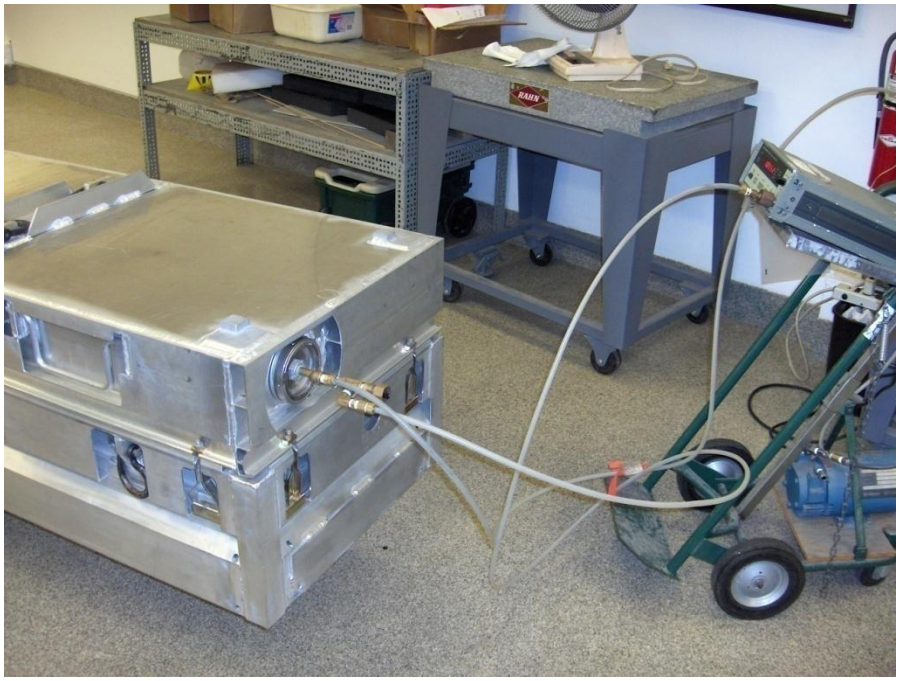


Figure 8. Pressure Test Set-up (for both pressure and vacuum).

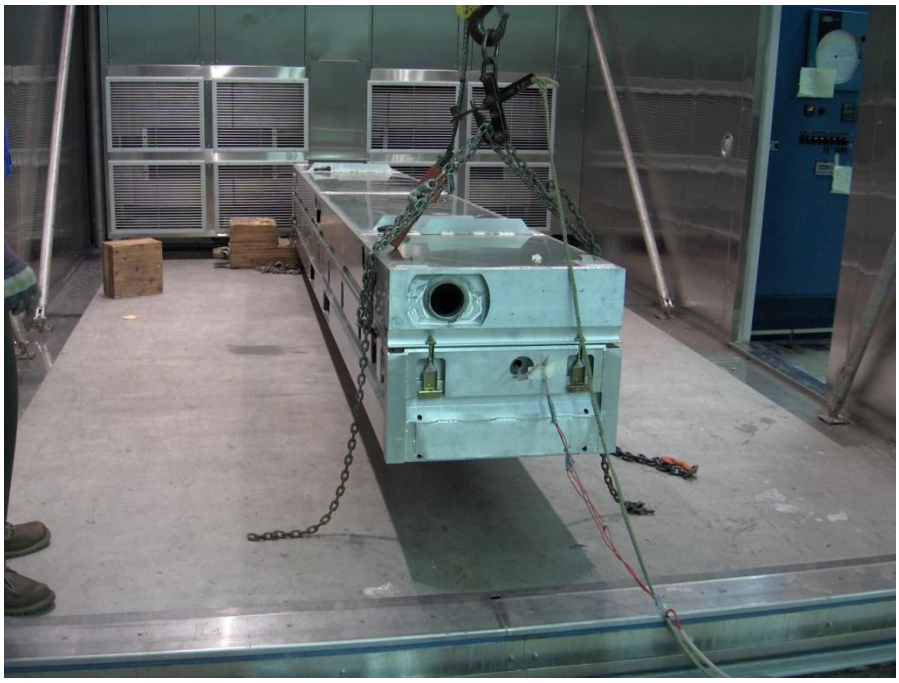


Figure 9. Rotational Edge Drop, End.

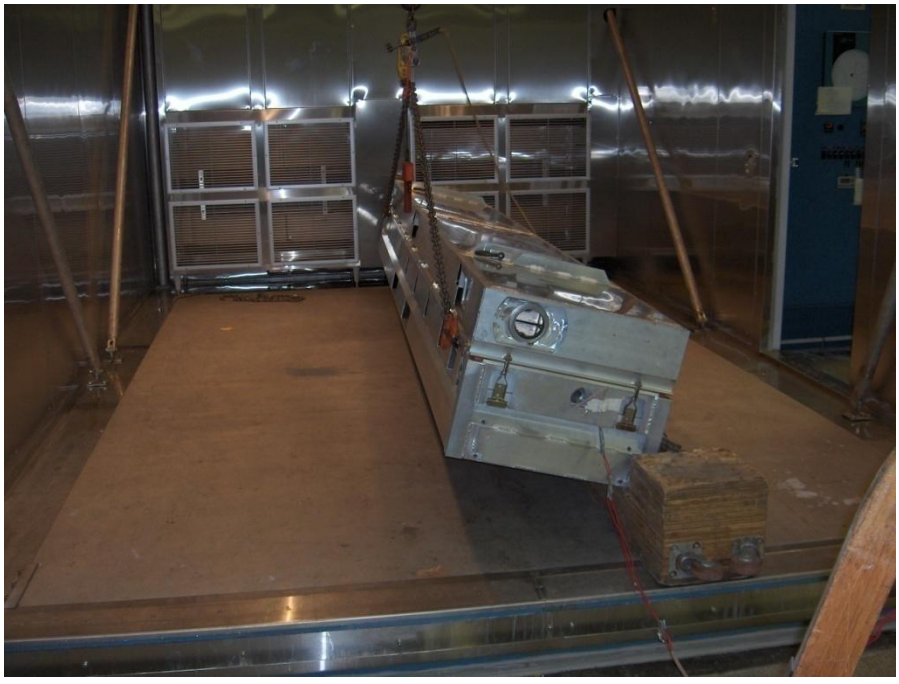


Figure 10. Rotational Edge Drop, Side.

Figure 11. Rotational Corner Drop.

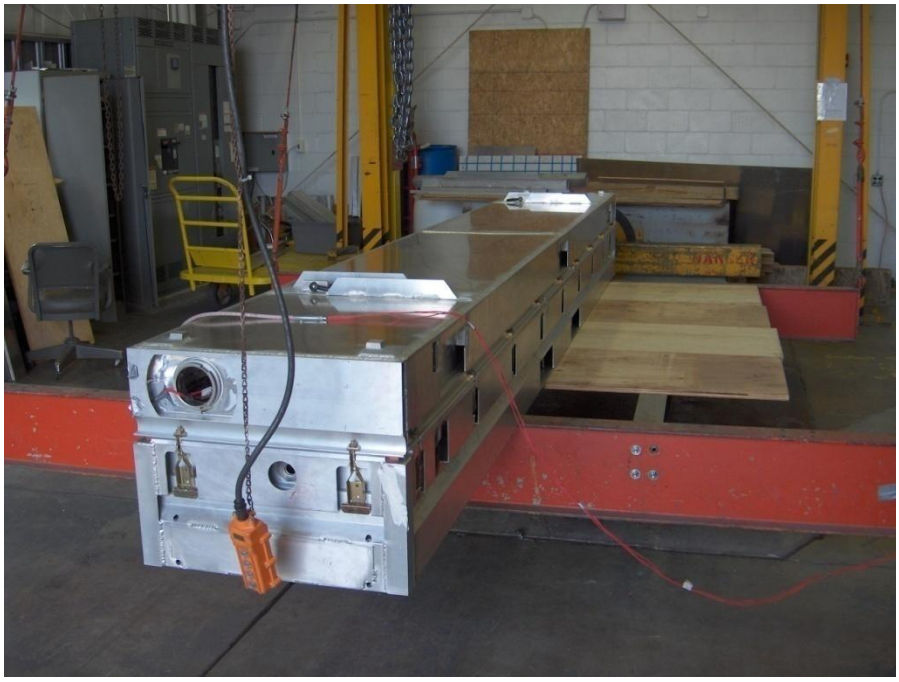


Figure 12. Pendulum Impact Test.

Figure 13. Resonance Sweep and Dwell Test.

APPENDIX 3: Test Data

Table 1. HH-60 Fuel Probe Impact Test Summary (filtered data)

IMPACT TYPE	TEST TEMPERATURE	IMPACT LOCATION	RESULTANT PEAK G
ROTATIONAL - EDGE	ambient	forward-bottom	31
ROTATIONAL - EDGE	ambient	aft-bottom	53
ROTATIONAL - EDGE	ambient	left-bottom	32
ROTATIONAL - EDGE	ambient	right-bottom	28
ROTATIONAL - CORNER	ambient	forward-left	31
ROTATIONAL - CORNER	ambient	forward-right	30
ROTATIONAL - CORNER	ambient	aft-left	34
ROTATIONAL - CORNER	ambient	aft-right	41
LATERAL IMPACT - FACE	ambient	forward	60
LATERAL IMPACT - FACE	ambient	aft	50

TABLE 2. Container Resonant Frequency and Transmissibility Values (from filtered waveforms).

TEST TEMPERATURE	DWELL TIME	RESONANT FREQUENCY	TRANSMISSIBILITY
Ambient	1 min	46.89 Hz	4
Ambient	15 min	49.44 Hz	5
Ambient	30 min	45.53 Hz	4

Table 3. HH-60 Fuel Probe Impact Test Summary (unfiltered data)

IMPACT TYPE	TEST TEMPERATURE	IMPACT LOCATION	RESULTANT PEAK G
ROTATIONAL - EDGE	ambient	forward-bottom	88
ROTATIONAL - EDGE	ambient	aft-bottom	101
ROTATIONAL - EDGE	ambient	left-bottom	70
ROTATIONAL - EDGE	ambient	right-bottom	53
ROTATIONAL - CORNER	ambient	forward-left	62
ROTATIONAL - CORNER	ambient	forward-right	71
ROTATIONAL - CORNER	ambient	aft-left	93
ROTATIONAL - CORNER	ambient	aft-right	100
LATERAL IMPACT - FACE	ambient	forward	73
LATERAL IMPACT - FACE	ambient	aft	103

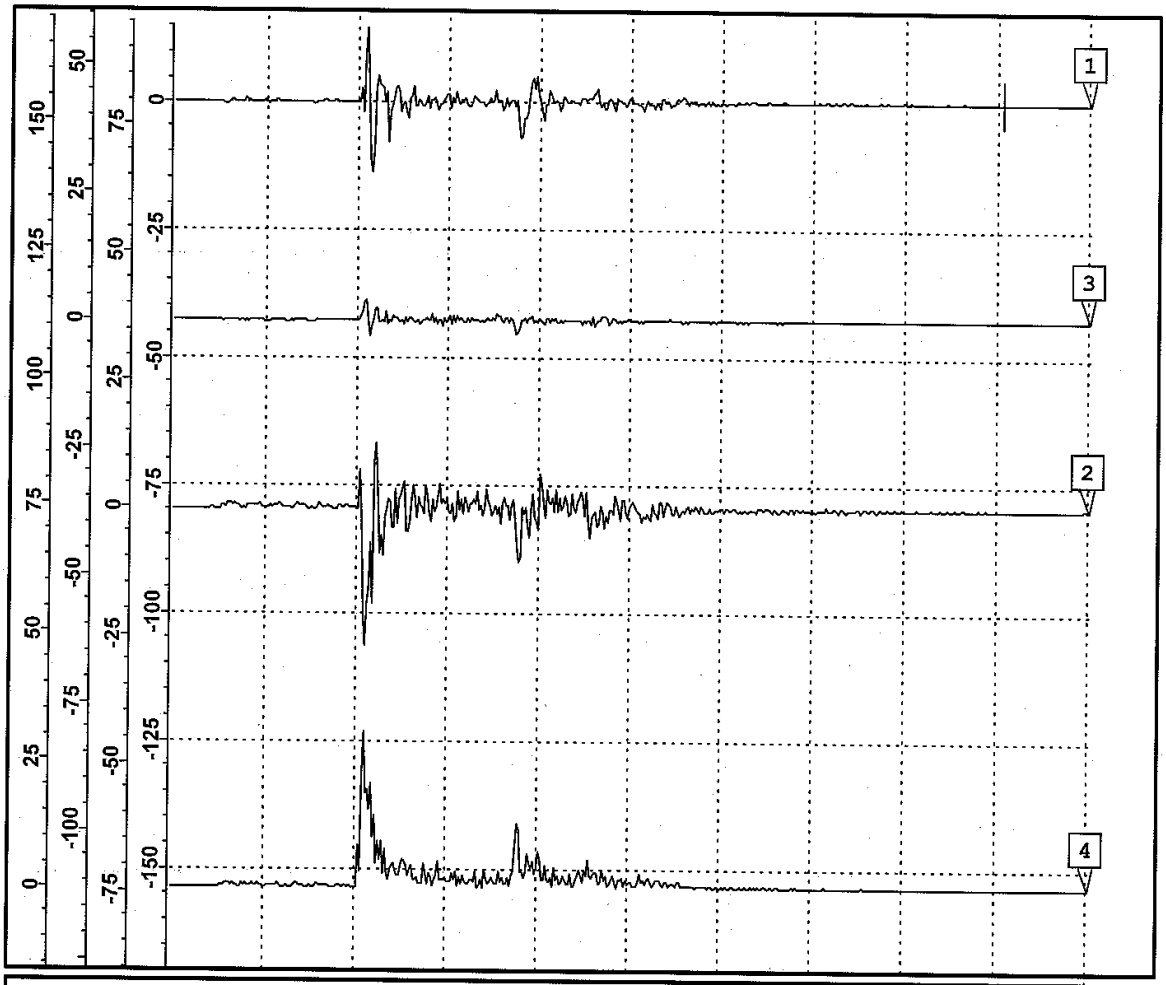
NOTE: The first set of the following waveforms are filtered data, with the filtering frequency shown at the top of the waveform traces. The second set of waveforms is the unfiltered data provided for comparison. Unfiltered vibration waveforms are not included because the extreme levels of noise make them indecipherable.

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:42	Impact Orient.:	Forward bottom edge
Test Engineer:	Evans	Drop Height:	12 in.
Container:	Al/probe	Accelerometer:	2228C, S/N 16471

V. Angle: 51.34;H.Angle: 163.74; Filter: = 140 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	919. mS	0.06 g's	18.18 g's	17.30 In/s	131 mS	1	2
2	919. mS	-0.07 g's	-26.78 g's	-49.19 In/s	131 mS	1	2
3	919. mS	0.02 g's	4.98 g's	10.87 In/s	131 mS	1	2
R	919. mS	0.10 g's	30.54 g's	53.27 In/s	131 mS	1	2

Remarks

Peak G X: 18 Y: 5 Z: 27 Peak G Resultant: 31
Filtered at 140 Hz.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads.**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

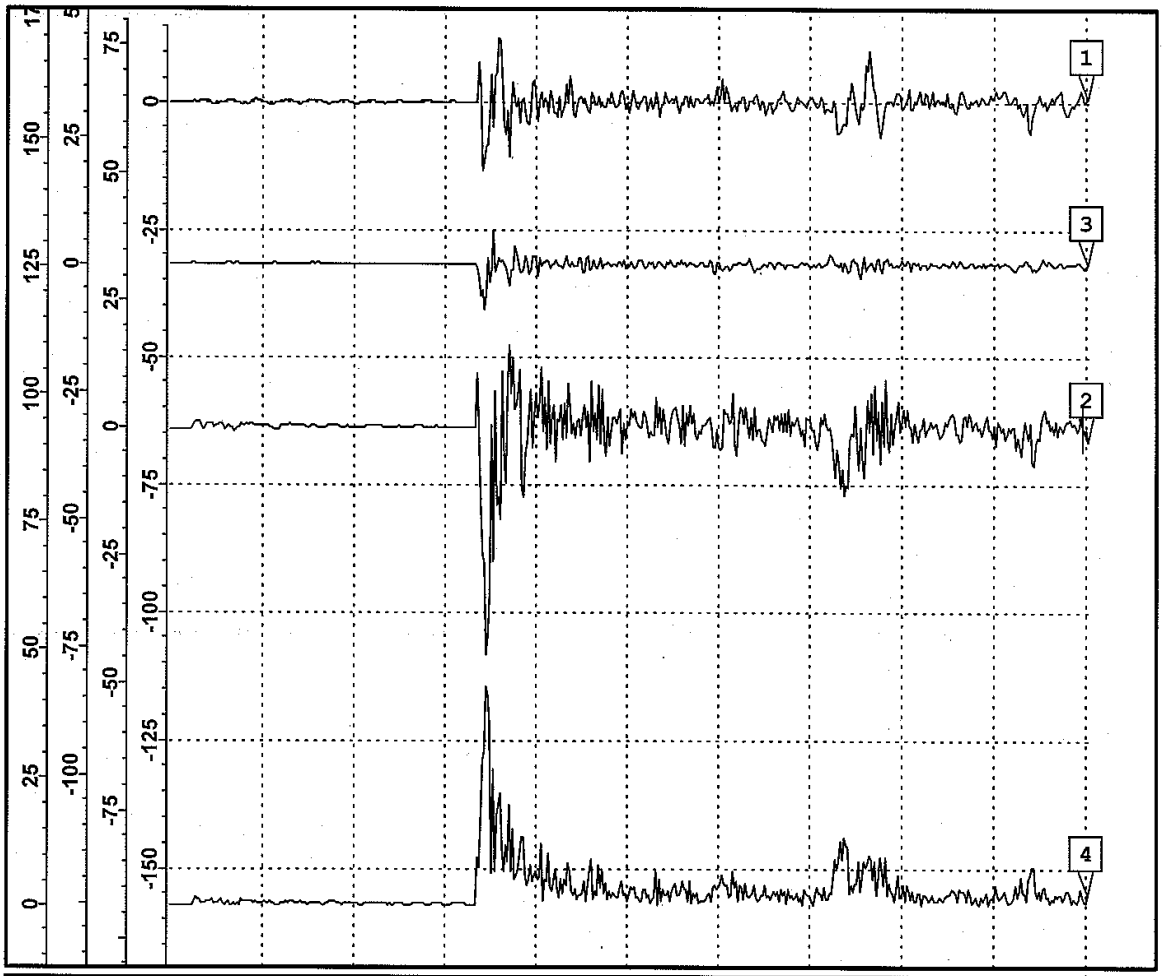
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:28	**Impact Orient.:**	Aft bottom edge
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe	**Accelerometer:**	2228C, S/N 16471

V. Angle: 13.16;H.Angle: 290.56; Filter: = 187 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	431. mS	1.45 g's	16.78 g's	-11.01 In/s	66 mS	2	2
2	431. mS	0.12 g's	-52.13 g's	-18.57 In/s	66 mS	2	2
3	431. mS	-0.32 g's	-9.52 g's	-18.52 In/s	66 mS	2	2
R	431. mS	1.60 g's	53.08 g's	28.45 In/s	66 mS	2	2

Remarks

Peak G X: 17 Y: 10 Z: 52 Peak G Resultant: 53
Filtered at 187 Hz.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads.**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

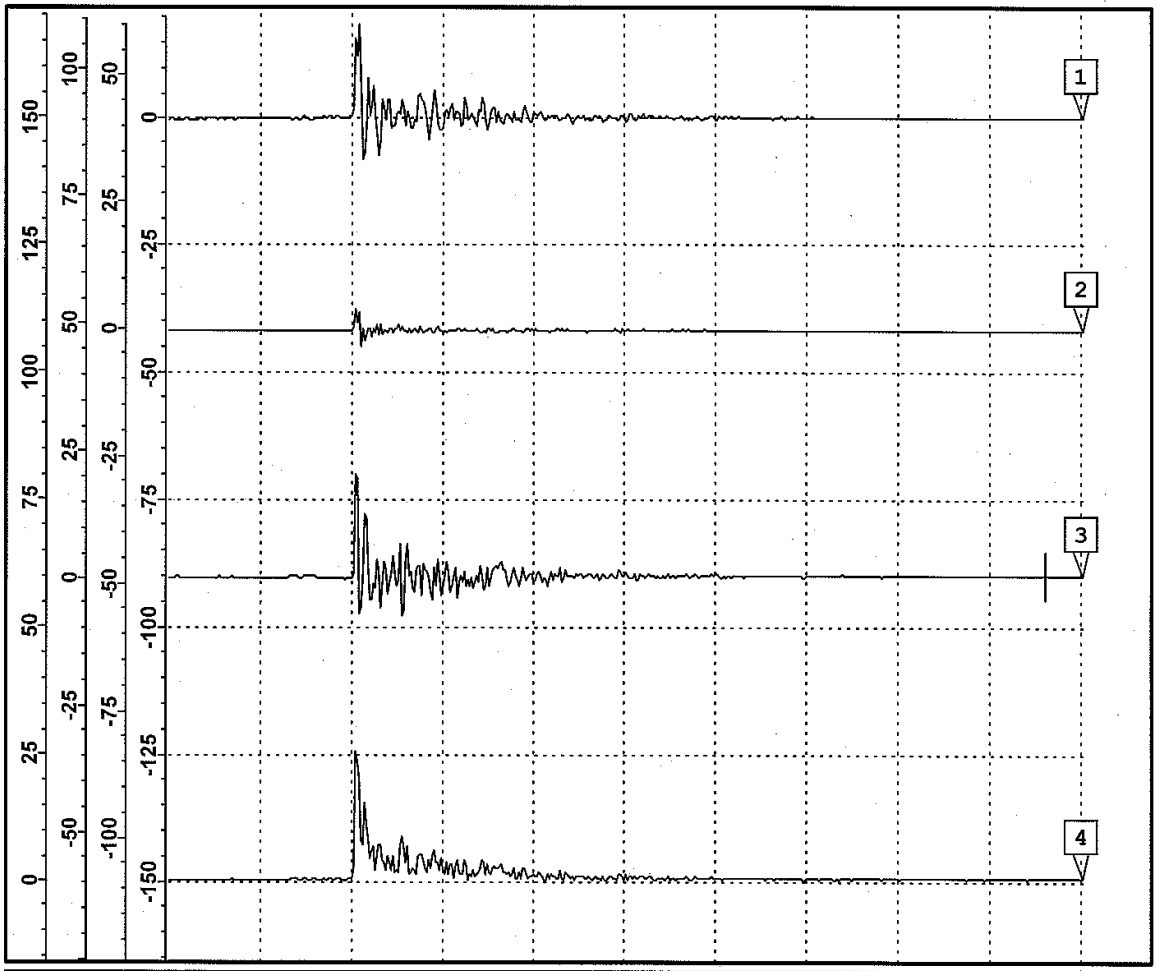
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	**Oct 1 2009 15:53**	**Impact Orient.:**	**Left bottom edge**
Test Engineer:	**Evans**	**Drop Height:**	**12 in.**
Container:	**Al/probe**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 67.36;H.Angle: 86.25; Filter: = 115 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	993. mS	0.16 g's	24.55 g's	200.11 In/s	131 mS	1	2
○	2	993. mS	0.02 g's	4.74 g's	14.39 In/s	131 mS	1	2
◉	3	993. mS	0.37 g's	25.45 g's	190.61 In/s	131 mS	1	2
○	R	993. mS	0.41 g's	31.84 g's	276.74 In/s	131 mS	1	2

Remarks

Peak G X: 25 Y: 5 Z: 25 Peak G Resultant: 32
Filtered at 115 Hz.
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

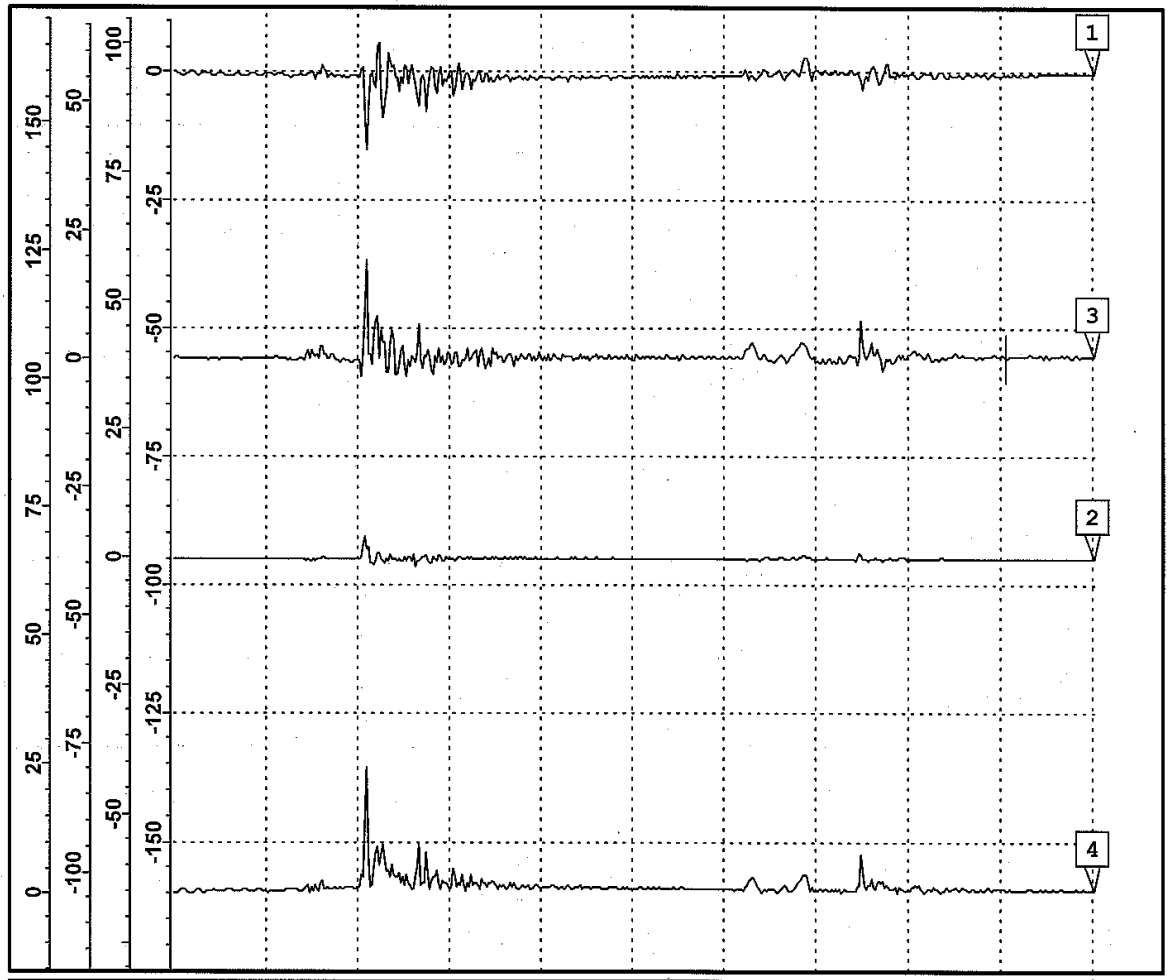
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	**Oct 1 2009 15:56**	**Impact Orient.:**	**Right bottom edge**
Test Engineer:	**Evans**	**Drop Height:**	**12 in.**
Container:	**Al/probe**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 169.61;H.Angle: 69.44; Filter: = 93 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	919. mS	-0.71 g's	-15.34 g's	-424.87 In/s	131 mS	1	2
2	919. mS	0.05 g's	4.29 g's	82.02 In/s	131 mS	1	2
3	919. mS	0.12 g's	22.88 g's	130.51 In/s	131 mS	1	2
R	919. mS	0.72 g's	27.53 g's	451.96 In/s	131 mS	1	2

Remarks

Peak G X: 15 Y: 4 Z: 23 Peak G Resultant: 28
Filtered at 93 Hz.
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

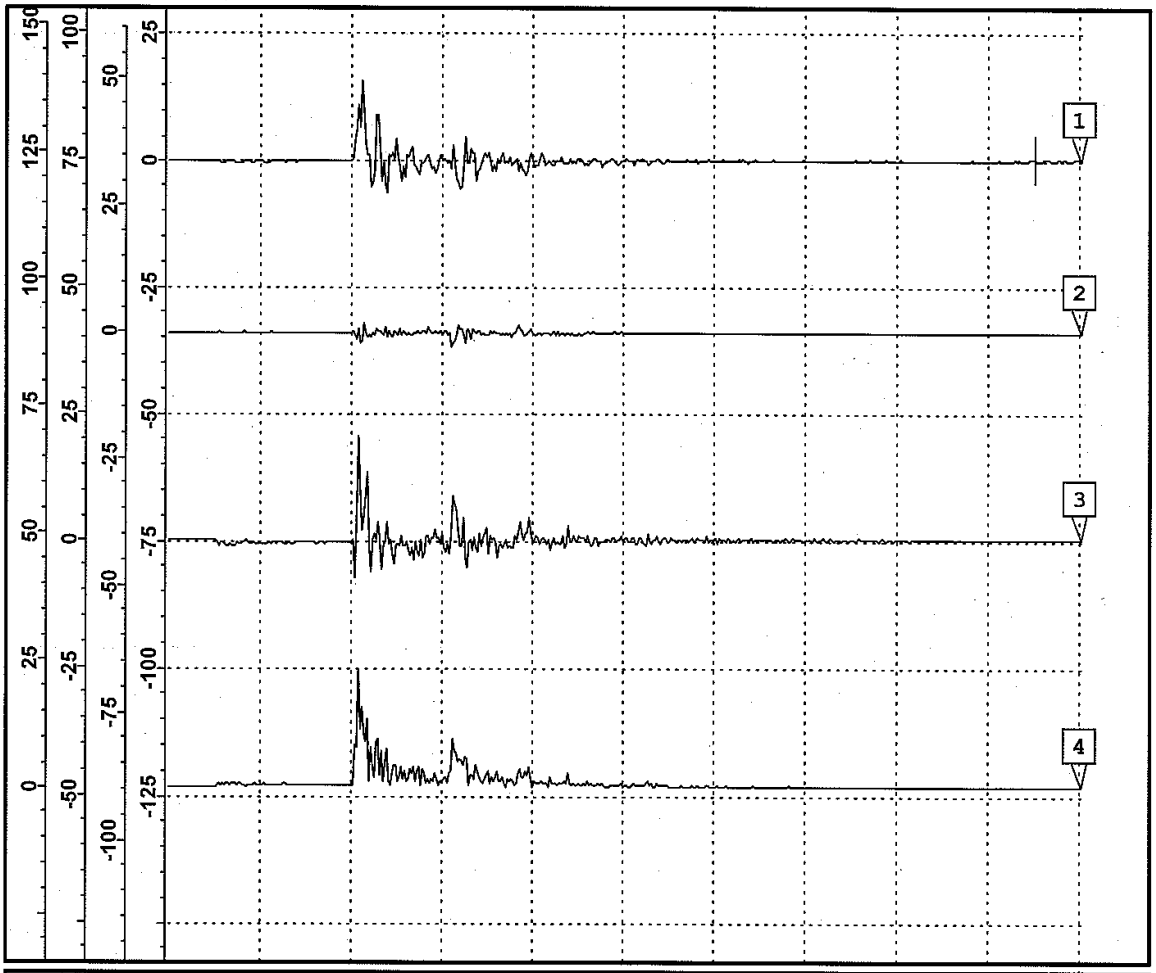
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:49	**Impact Orient.:**	Forward-left corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe	**Accelerometer:**	2228C, S/N 16471

V. Angle: 18.72;H.Angle: 30.26; Filter: = 115 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.24 S	0.13 g's	23.22 g's	-15.44 In/s	131 mS	1	2
2	1.24 S	0.04 g's	-3.28 g's	-7.05 In/s	131 mS	1	2
3	1.24 S	0.02 g's	30.22 g's	-23.42 In/s	131 mS	1	2
R	1.24 S	0.13 g's	30.79 g's	28.92 In/s	131 mS	1	2

Remarks

Peak G X: 23 Y: 3 Z: 31 Peak G Resultant: 31
Filtered at 115 Hz.
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

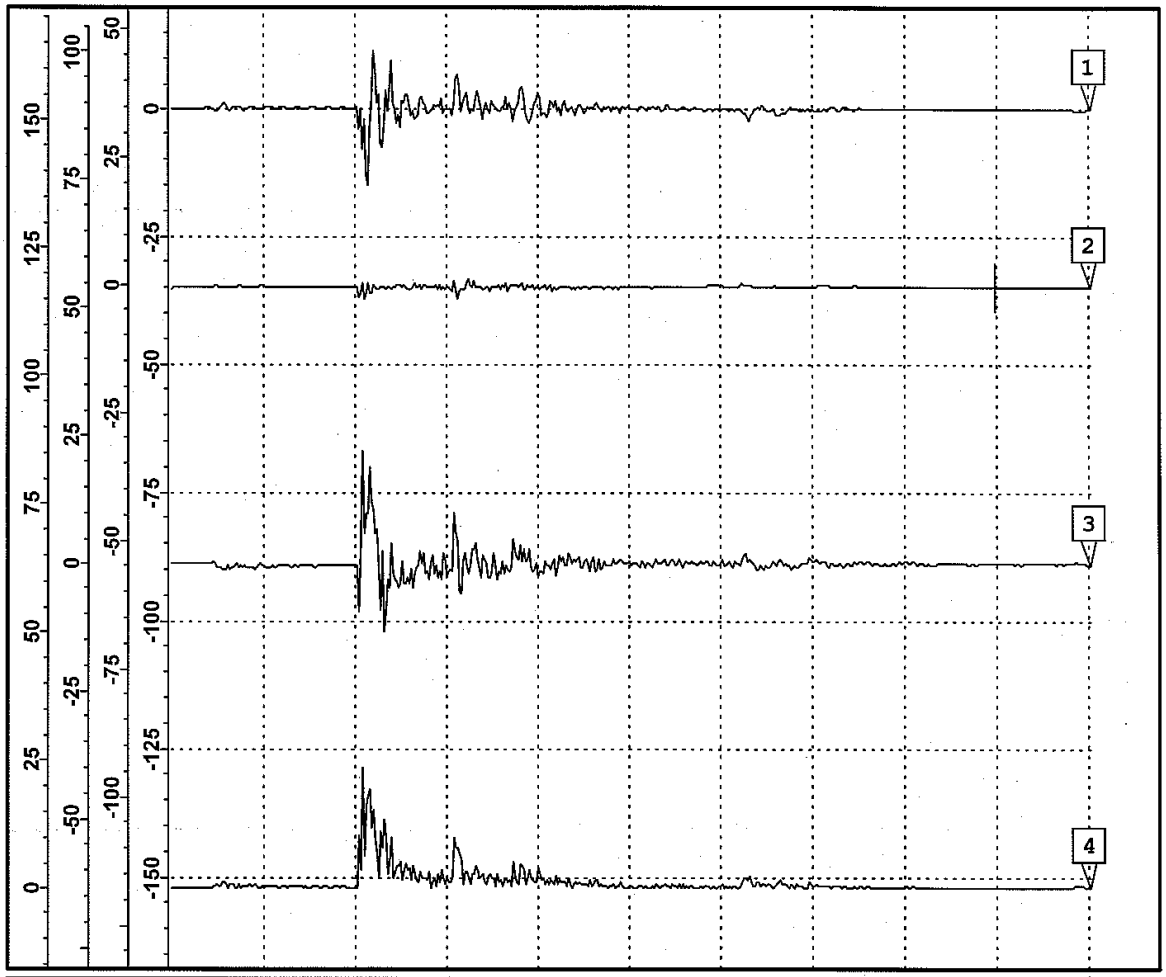
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:46	**Impact Orient.:**	Forward-right corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe	**Accelerometer:**	2228C, S/N 16471

V. Angle: 118.84;H.Angle: 82.41; Filter: = 178 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	908. mS	-0.15 g's	-20.81 g's	-5.31 In/s	131 mS	1	2
2	908. mS	0.04 g's	-3.65 g's	0.40 In/s	131 mS	1	2
3	908. mS	0.27 g's	29.21 g's	-1.31 In/s	131 mS	1	2
R	908. mS	0.32 g's	30.28 g's	5.48 In/s	131 mS	1	2

Remarks

Peak G X: 21 Y: 4 Z: 30 Peak G Resultant: 30
Filtered at 178 Hz.
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

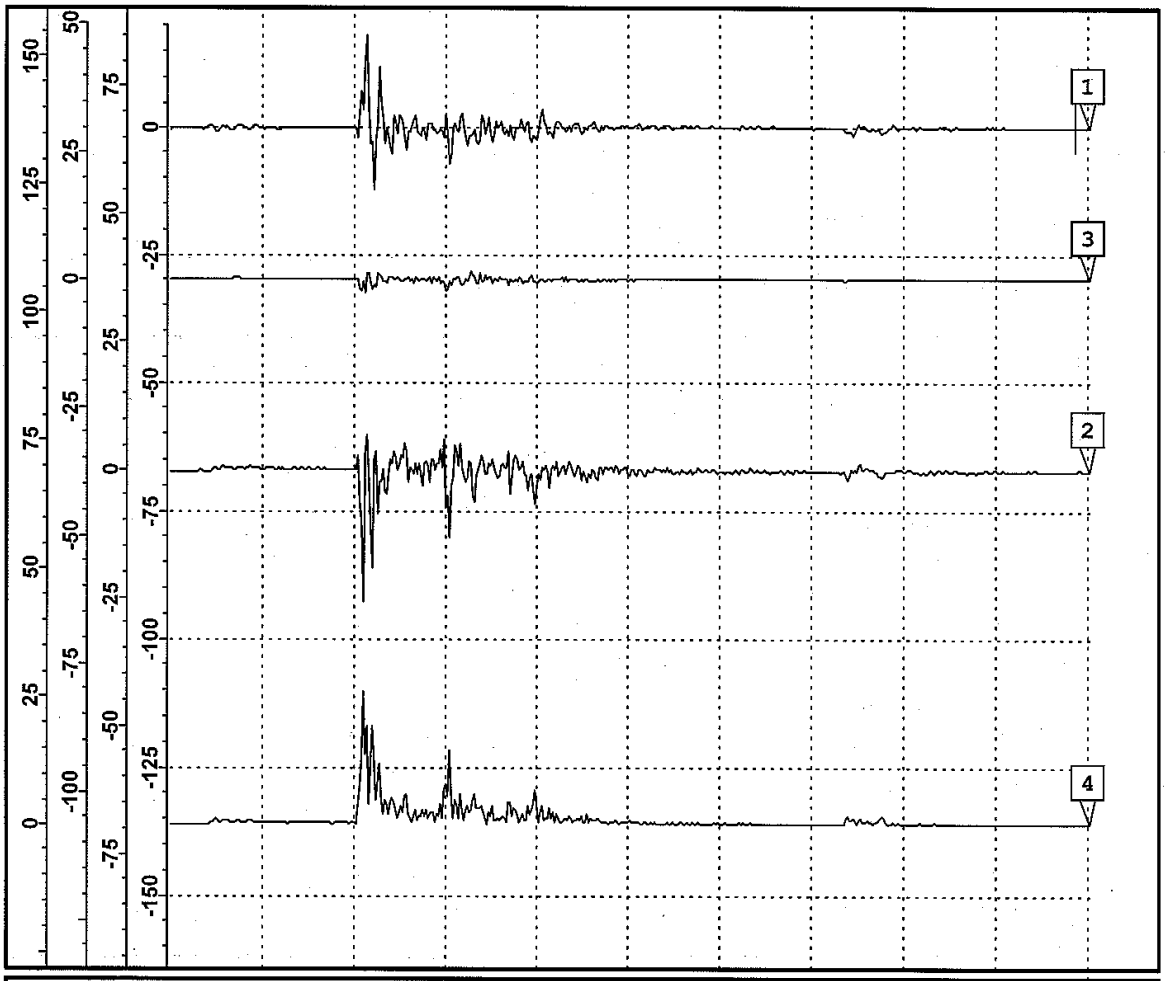
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	**Oct 1 2009 15:35**	**Impact Orient.:**	**aft left corner**
Test Engineer:	**Evans**	**Drop Height:**	**12 in.**
Container:	**Al/probe**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 38.33;H.Angle: 71.57; Filter: = 130 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.29 S	0.09 g's	17.86 g's	-12.46 In/s	131 mS	1	2
2	1.29 S	0.02 g's	-33.94 g's	-15.14 In/s	131 mS	1	2
3	1.29 S	0.06 g's	-4.97 g's	0.19 In/s	131 mS	1	2
R	1.29 S	0.11 g's	34.43 g's	19.61 In/s	131 mS	1	2

Remarks

Peak G X: 18 Y: 5 Z: 34 Peak G Resultant: 34
Filtered at 130 Hz.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads.**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

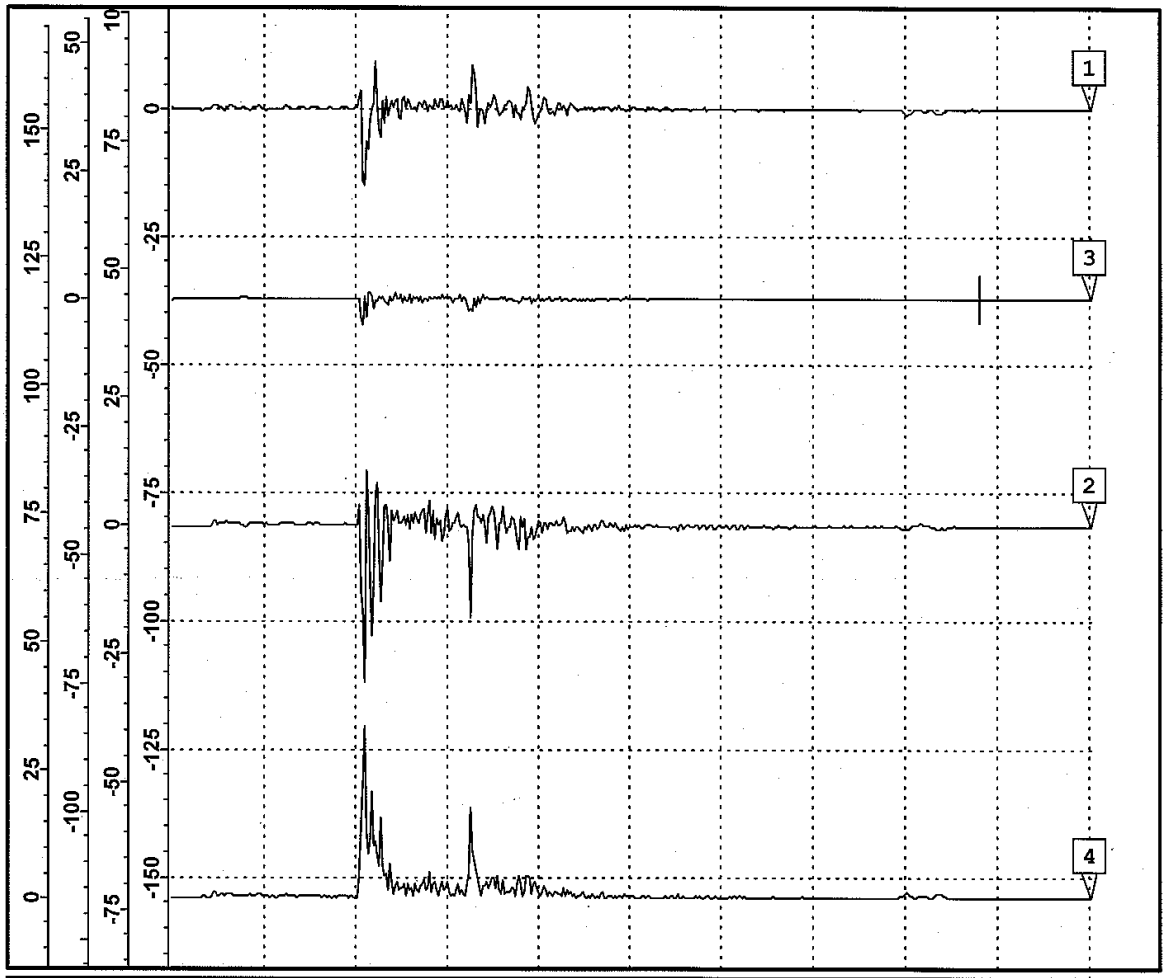
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:33	**Impact Orient.:**	Aft right corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe	**Accelerometer:**	2228C, S/N 16471

V. Angle: 141.79;H.Angle: 150.35; Filter: = 115 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div		Hexp	Vexp
○	1	893.	mS	-0.29 g's	-16.33 g's	-11.51 In/s	131	mS	1	2
○	2	893.	mS	-0.20 g's	-37.36 g's	-35.63 In/s	131	mS	1	2
◉	3	893.	mS	0.11 g's	-5.11 g's	27.56 In/s	131	mS	1	2
○	R	885.	mS	0.37 g's	40.74 g's	46.49 In/s	131	mS	1	2

Remarks

Peak G X: 16 Y: 5 Z: 37 Peak G Resultant: 41
Filtered at 115 Hz.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads.**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

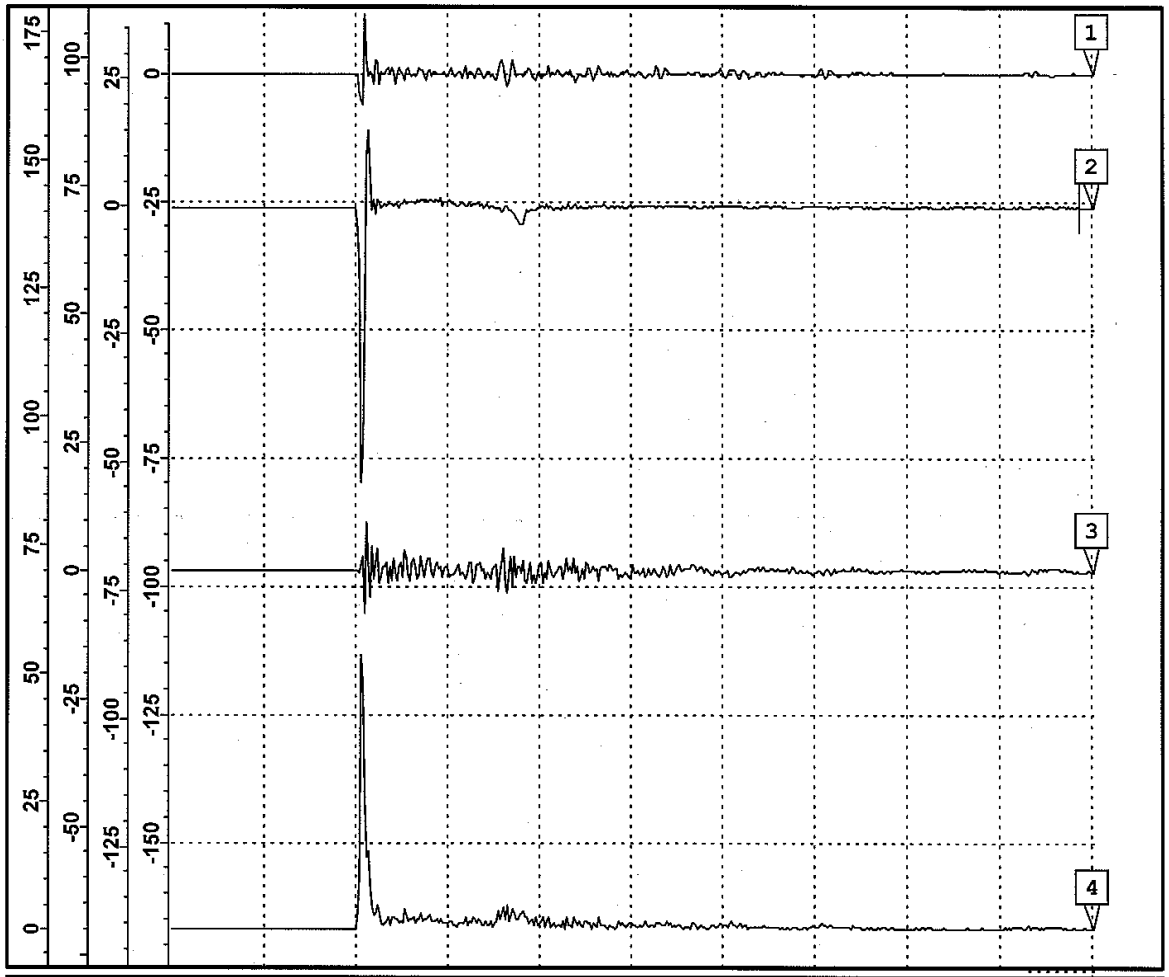
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

PENDULUM IMPACTS

Time:	**Oct 1 2009 14:38**	**Impact Orient.:**	**Forward side**
Test Engineer:	**Evans**	**Velocity:**	**7.3 ft/sec**
Container:	**Al/probe**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 111.54;H.Angle: 306.98; Filter: = 150 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.29 S	-0.13 g's	12.88 g's	19.73 In/s	131 mS	1	2
2	1.29 S	0.20 g's	-58.57 g's	30.19 In/s	131 mS	1	2
3	1.29 S	-0.26 g's	-16.03 g's	0.46 In/s	131 mS	1	2
R	1.29 S	0.35 g's	60.28 g's	36.07 In/s	131 mS	1	2

Remarks

Peak G X: 13 Y: 59 Z: 16 Peak G Resultant: 60
Filtered at 150 Hz.
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

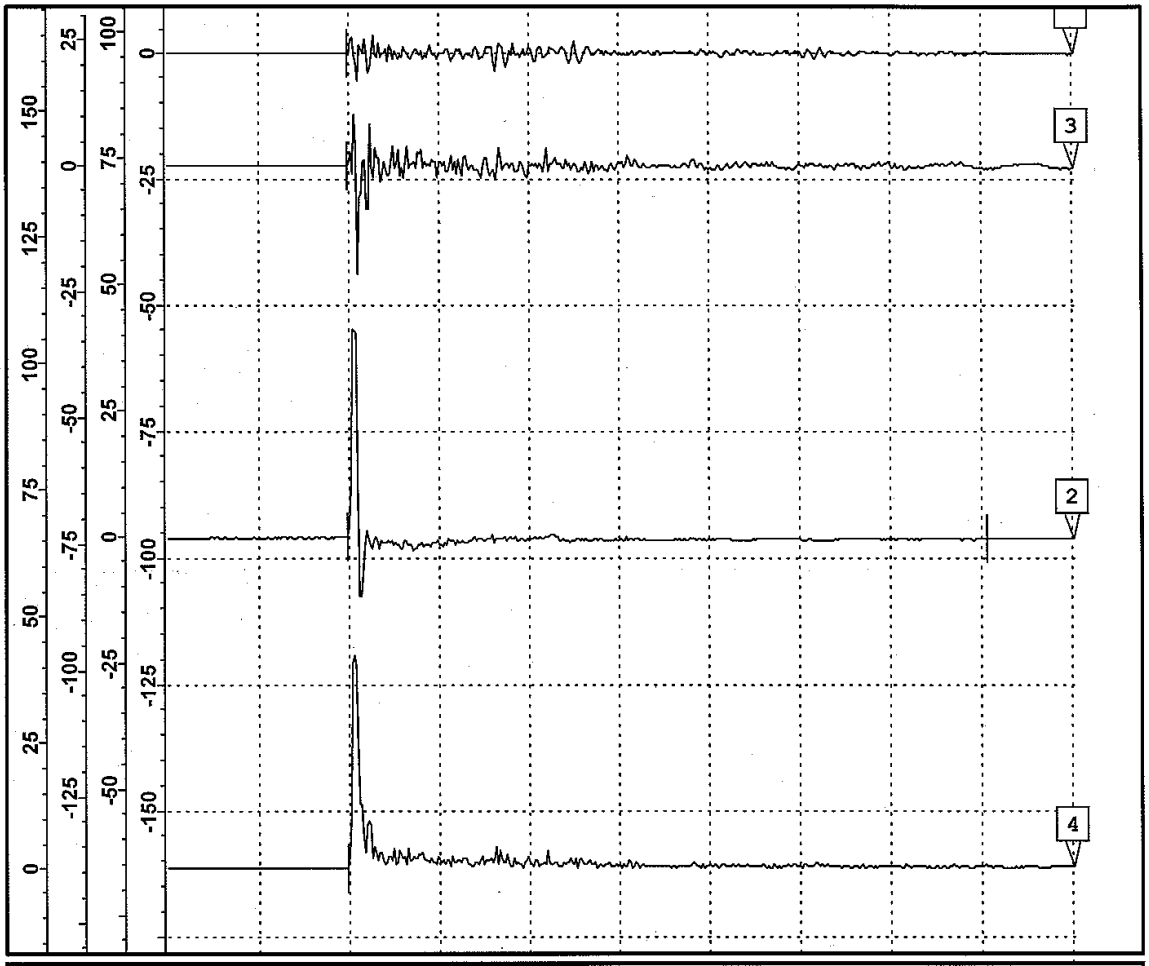
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

PENDULUM IMPACTS

Time:	**Oct 1 2009 14:32**	**Impact Orient.:**	**aft side**
Test Engineer:	**Evans**	**Velocity:**	**7.3 ft/sec**
Container:	**Al/probe; clamp mod.**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 76.02;H.Angle: 241.48; Filter: = 140 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	924. mS	0.15 g's	-7.81 g's	-35.48 In/s	131 mS	1	2
2	924. mS	-0.29 g's	49.20 g's	-26.52 In/s	131 mS	1	2
3	924. mS	-0.53 g's	-21.69 g's	-32.85 In/s	131 mS	1	2
R	924. mS	0.62 g's	49.56 g's	55.15 In/s	131 mS	1	2

Remarks

Peak G X: 8 Y: 22 Z: 49 Peak G Resultant: 50
Item Wt. 153 lb. Filtered at 140 Hz.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

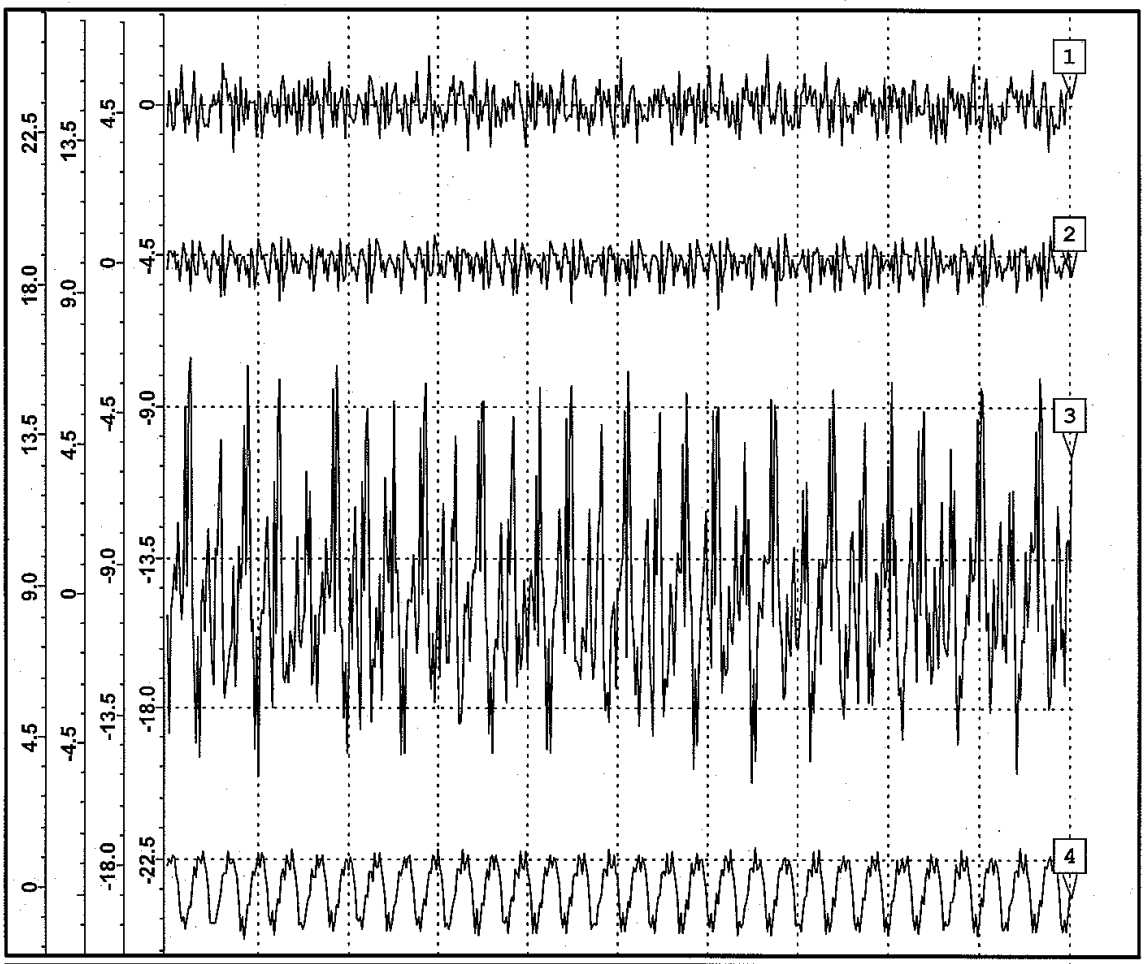
GHI SYSTEMS, INC. CAT SYSTEM

HH-60 Fuel Probe

RESONANCE SWEEP & DWELL

Time:	Oct 2 2009 12:29	**Test Engineer:**	Evans
Test Stage:	Dwell	**Frequency:**	46.89 Hz
Test Item:	Al/Probe	**Time in Test:**	1 minute

Filter: Ch.1 = 434 Hz Ch.2 = 434 Hz Ch.3 = 434 Hz



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	309. mS	0.13 g's	1.89 g's	0.67 In/s	66 mS	4	2
2	309. mS	-0.52 g's	-1.26 g's	3.44 In/s	66 mS	4	2
3	417. mS	-0.94 g's	7.58 g's	-4.09 In/s	66 mS	4	2
4	309. mS	-0.63 g's	-1.59 g's	1.51 In/s	66 mS	4	2

Remarks

Transmissibility: Z-axis = 4.08
Peak G X: 2 Gs Y: 1 Gs Z: 8 Gs Table Input(Ch.4): 2 Gs
Filtered at 434 Hz.

Ch.1=X(left-right); Ch.2=Y(forward-aft); Ch.3=Z(vertical).
Accelerometer: Model 2228C, S/N 16471
ASTM D4169, ASTM D999, SAE ARP 1967

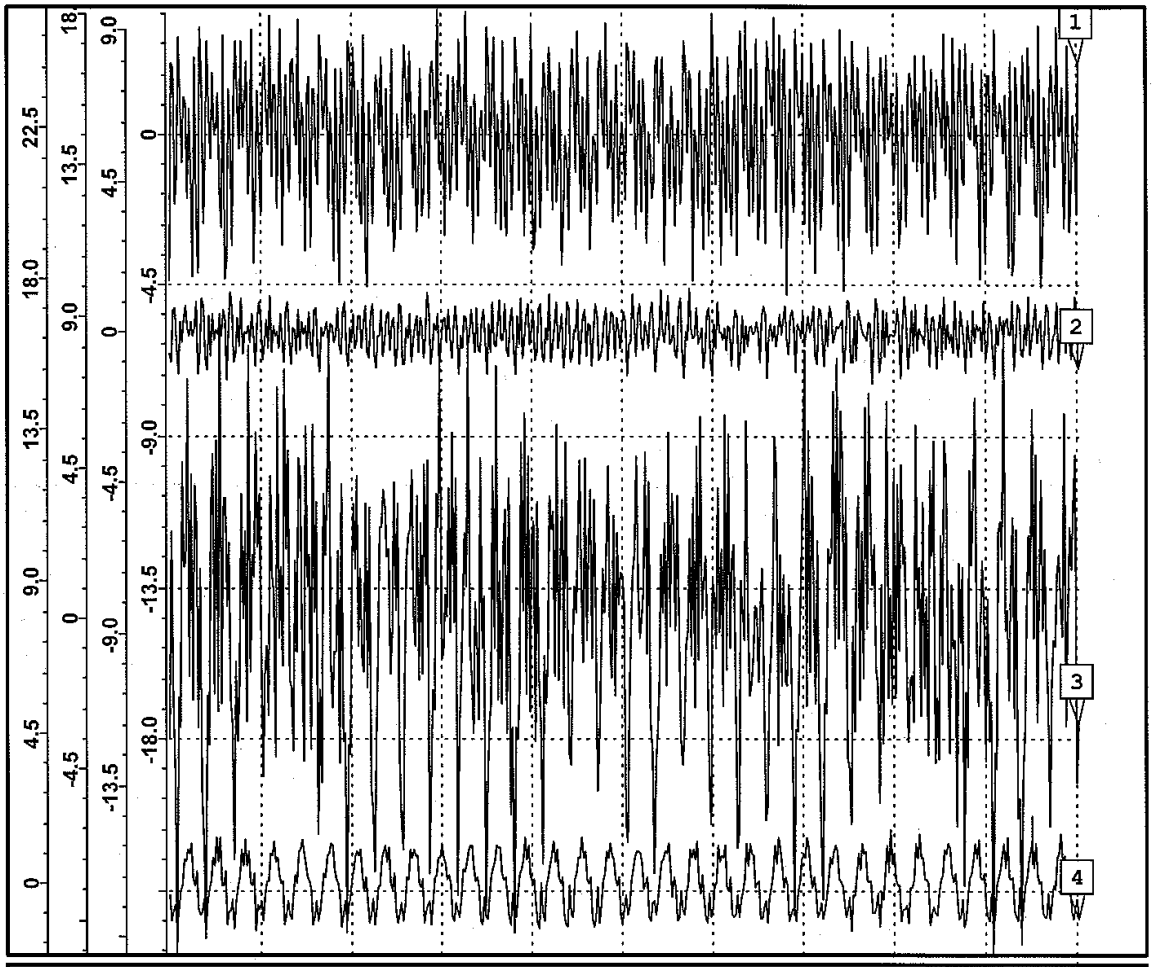
GHI SYSTEMS, INC. CAT SYSTEM

HH-60 Fuel Probe

RESONANCE SWEEP & DWELL

Time:	**Oct 2 2009 12:44**	**Test Engineer:**	**Evans**
Test Stage:	**Dwell**	**Frequency:**	**49.44 Hz**
Test Item:	**Al/Probe**	**Time in Test:**	**15 minutes**

Filter: Ch.1 = 434 Hz Ch.2 = 434 Hz Ch.3 = 434 Hz



	Ch.	Time		Curr Amp	Peak Amp	1st Int	Time/Div		Hexp	Vexp
○	1	614.	mS	2.40 g's	-5.02 g's	-3.80 In/s	66	mS	4	2
○	2	614.	mS	-0.69 g's	-1.50 g's	0.53 In/s	66	mS	4	2
○	3	638.	mS	1.38 g's	-11.14 g's	-5.31 In/s	66	mS	4	2
◉	4	620.	mS	1.33 g's	1.76 g's	2.70 In/s	66	mS	4	2

Remarks

Transmissibility: Z-axis = 5
Peak G X: 5 Gs Y: 2 Gs Z: 11 Gs Table Input(Ch.4): 2 Gs
Filtered at 434 Hz.

Ch.1=X(left-right); Ch.2=Y(forward-aft); Ch.3=Z(vertical).
Accelerometer: Model 2228C, S/N 16471
ASTM D4169, ASTM D999, SAE ARP 1967

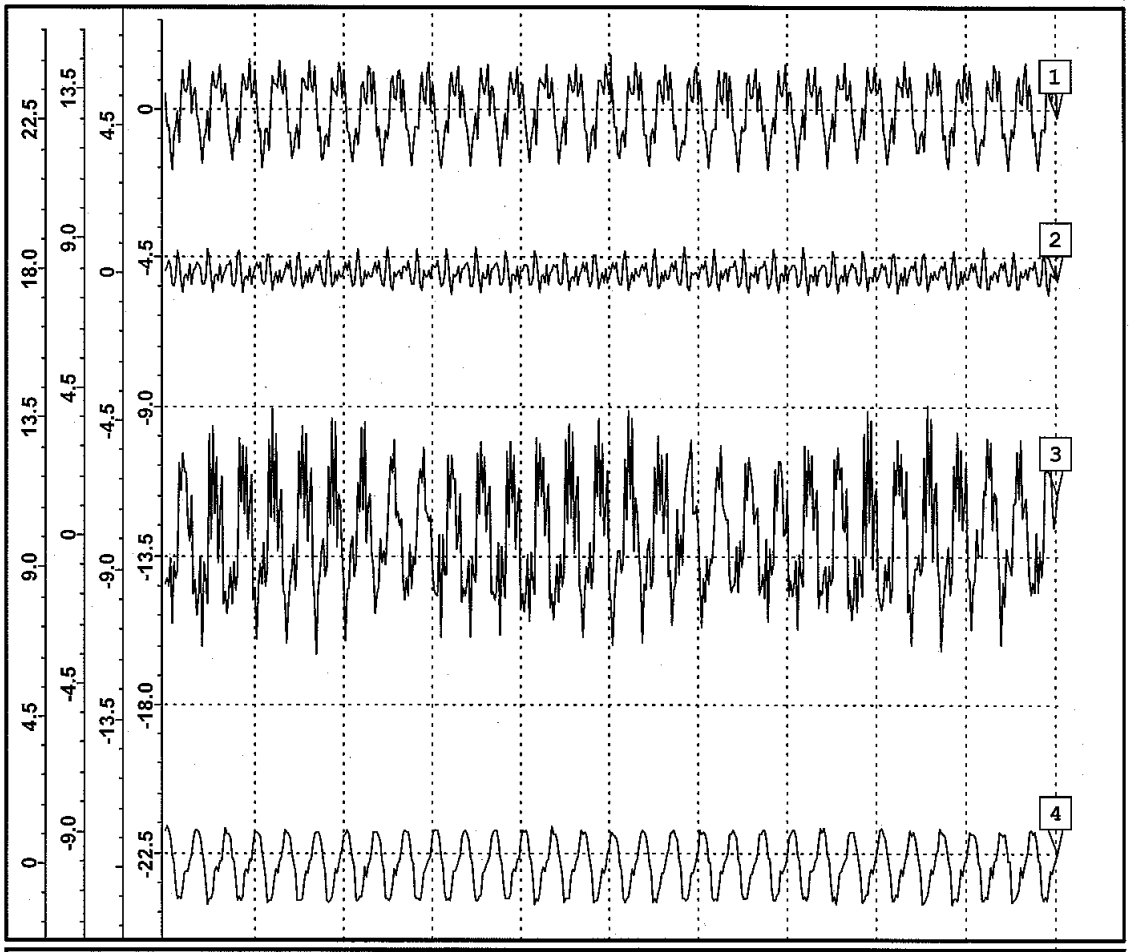
GHI SYSTEMS, INC. CAT SYSTEM

HH-60 Fuel Probe

RESONANCE SWEEP & DWELL

Time:	Oct 2 2009 12:59	**Test Engineer:**	Evans
Test Stage:	Dwell	**Frequency:**	45.53 Hz
Test Item:	Al/Probe	**Time in Test:**	30 minutes

Filter: Ch.1 = 230 Hz Ch.2 = 230 Hz Ch.3 = 230 Hz



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	327. mS	0.99 g's	-1.94 g's	4.05 In/s	66 mS	4	2
○	2	638. mS	0.04 g's	0.81 g's	4.16 In/s	66 mS	4	2
○	3	614. mS	-1.35 g's	4.04 g's	-6.53 In/s	66 mS	4	2
○	4	622. mS	-1.08 g's	-1.26 g's	-2.05 In/s	66 mS	4	2

Remarks

Transmissibility: Z-axis = 4
Peak G X: 2 Gs Y: 1 Gs Z: 4 Gs Table Input(Ch.4): 1 Gs
Filtered at 230 Hz.

Ch.1=X(left-right); Ch.2=Y(forward-aft); Ch.3=Z(vertical).
Accelerometer: Model 2228C, S/N 16471
ASTM D4169, ASTM D999, SAE ARP 1967

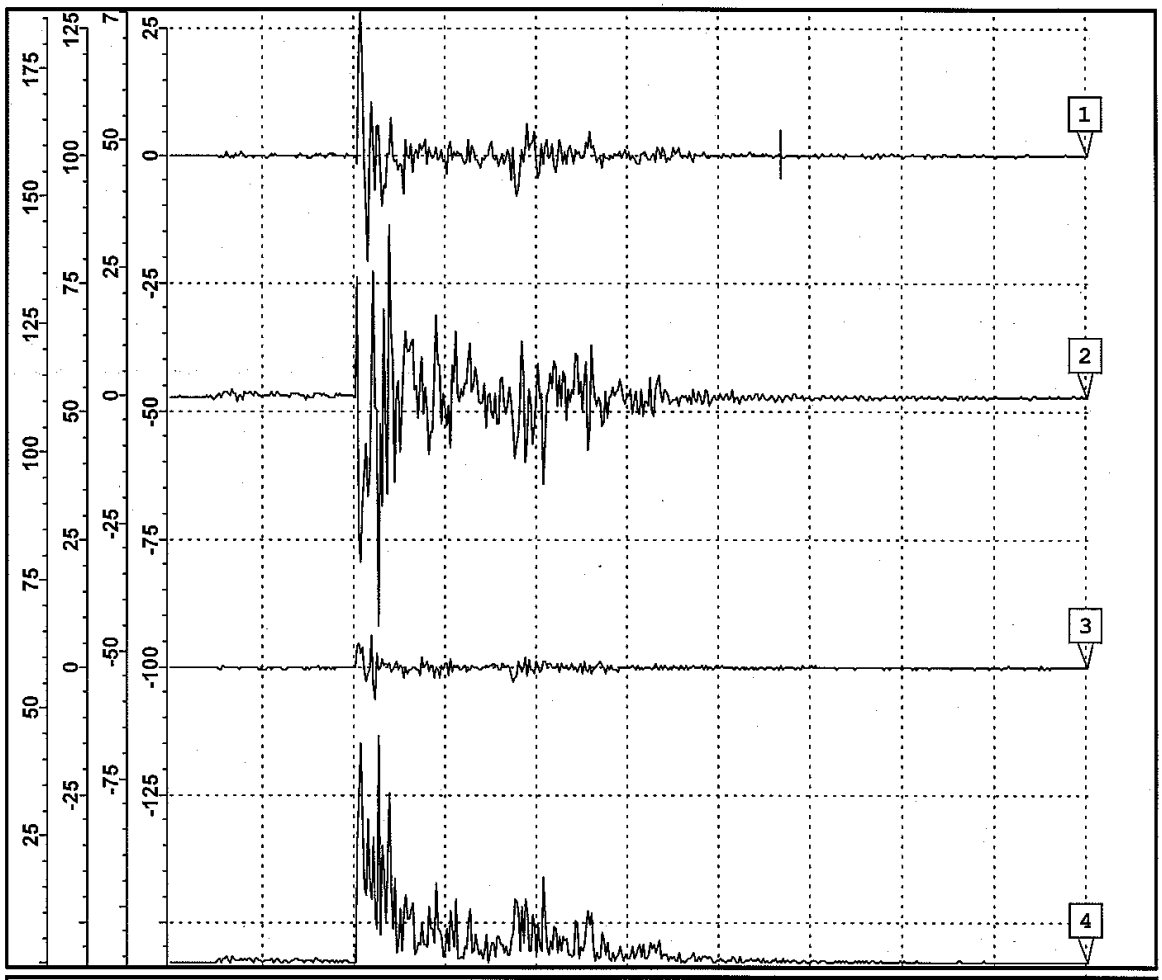
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:42	**Impact Orient.:**	forward bottom edge
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 52.45;H.Angle: 79.58;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	872. mS	0.21 g's	36.73 g's	28.47 In/s	131 mS	1	2
2	872. mS	0.05 g's	88.13 g's	-51.20 In/s	131 mS	1	2
3	872. mS	0.27 g's	-8.77 g's	9.79 In/s	131 mS	1	2
R	872. mS	0.34 g's	88.30 g's	59.39 In/s	131 mS	1	2

Remarks

Peak G X: 37 Y: 88 Z: 9 Peak G Resultant: 88
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); Ch.2=Y(vert); Ch.3=Z(frwd-aft); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

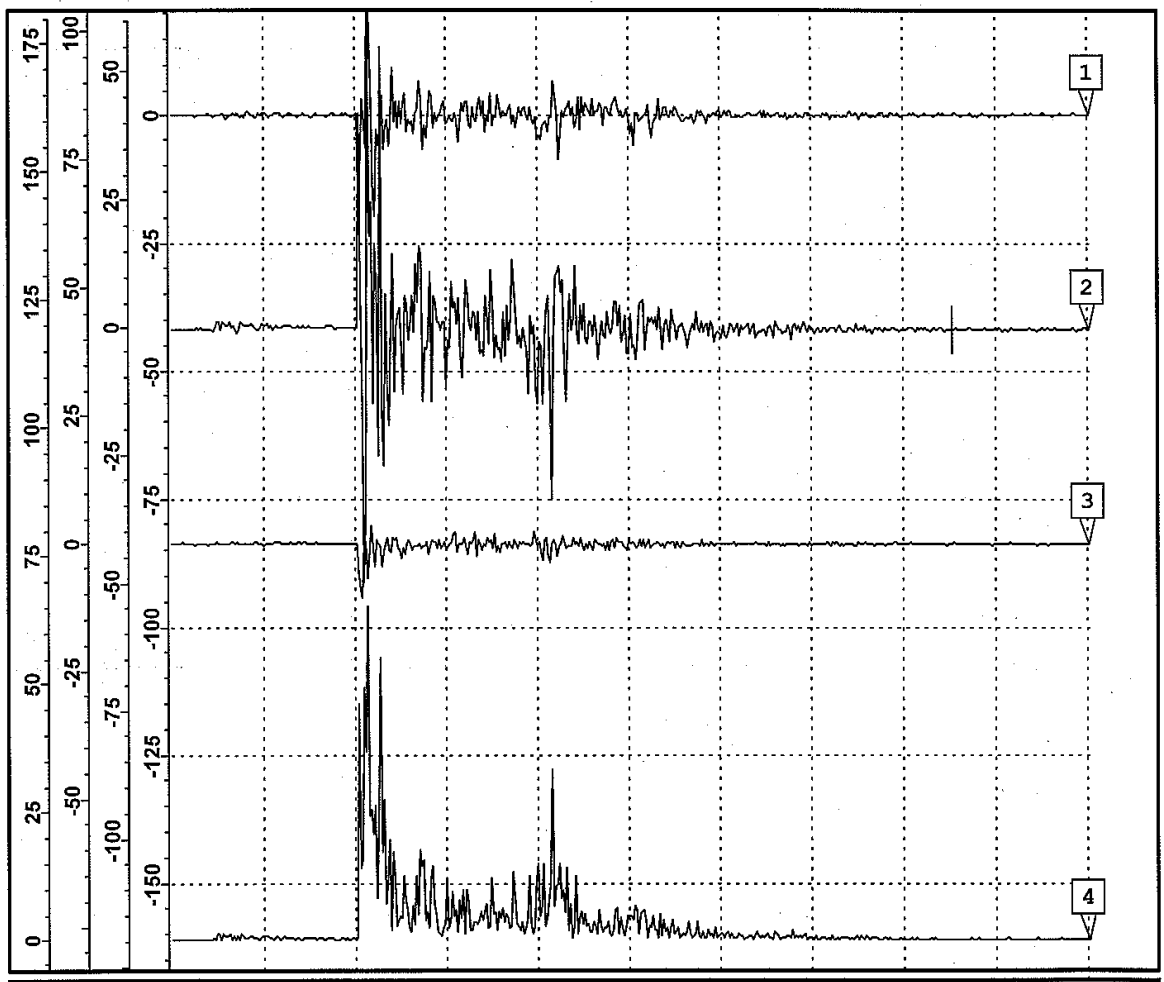
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	**Oct 1 2009 15:28**	**Impact Orient.:**	**Aft bottom edge**
Test Engineer:	**Evans**	**Drop Height:**	**12 in.**
Container:	**Al/probe; clamp mod.**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 142.29;H.Angle: 237.99;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.11 S	-0.19 g's	37.36 g's	-37.11 In/s	131 mS	1	2
2	1.11 S	-0.08 g's	-99.49 g's	105.72 In/s	131 mS	1	2
3	1.11 S	-0.12 g's	-13.40 g's	-58.30 In/s	131 mS	1	2
R	1.11 S	0.24 g's	100.86 g's	126.30 In/s	131 mS	1	2

Remarks

Peak G X: 37 Y: 99 Z: 13 Peak G Resultant: 101
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); Ch.2=Y(vert); Ch.3=Z(frwd-aft); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

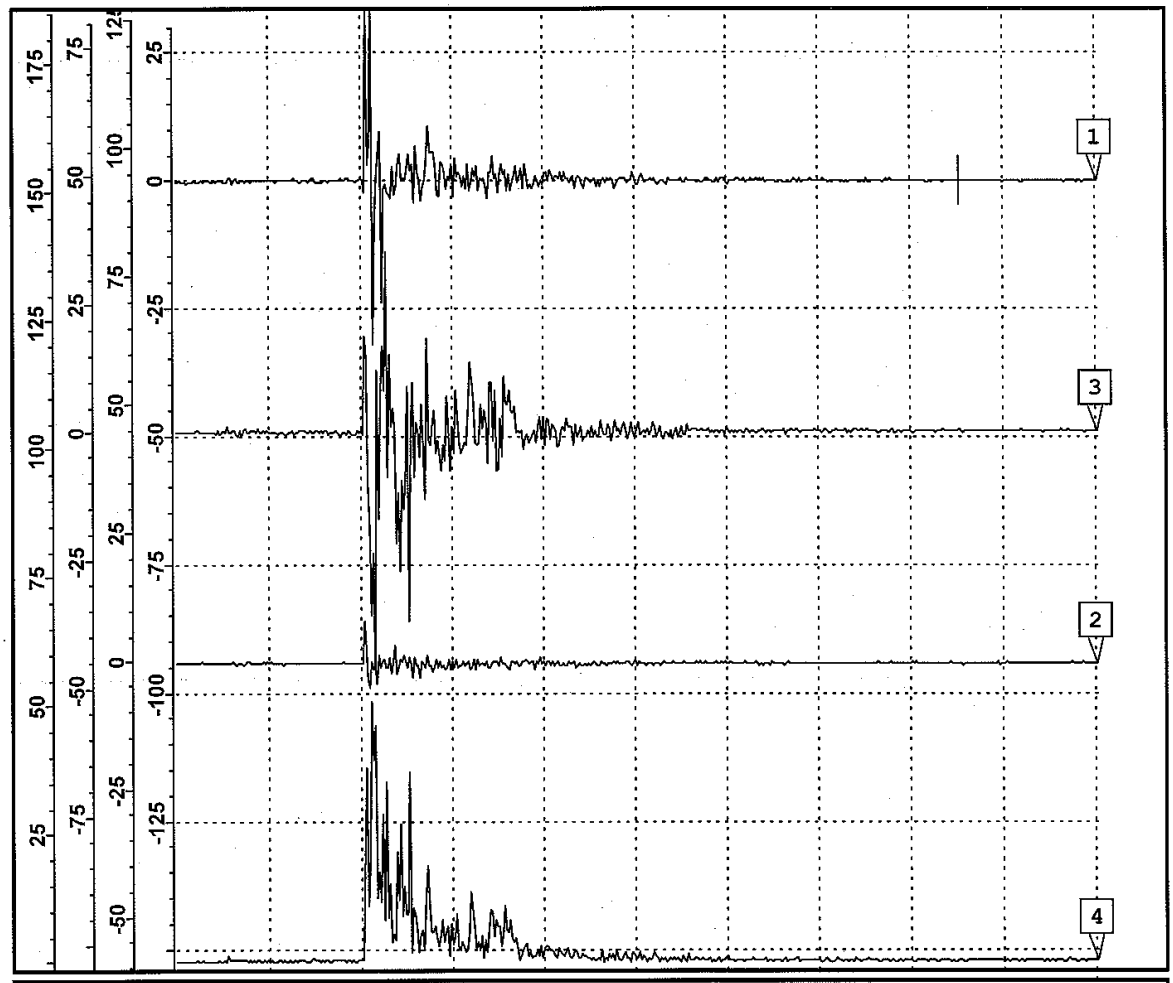
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:53	**Impact Orient.:**	left bottom edge
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 78.96;H.Angle: 98.35;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.11 S	0.13 g's	47.84 g's	192.90 In/s	131 mS	1	2
2	1.11 S	-0.10 g's	9.81 g's	-11.79 In/s	131 mS	1	2
3	1.11 S	0.67 g's	69.56 g's	26.59 In/s	131 mS	1	2
R	1.11 S	0.69 g's	69.65 g's	195.08 In/s	131 mS	1	2

Remarks

Peak G X: 48 Y: 70 Z: 10 Peak G Resultant: 70
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=X(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

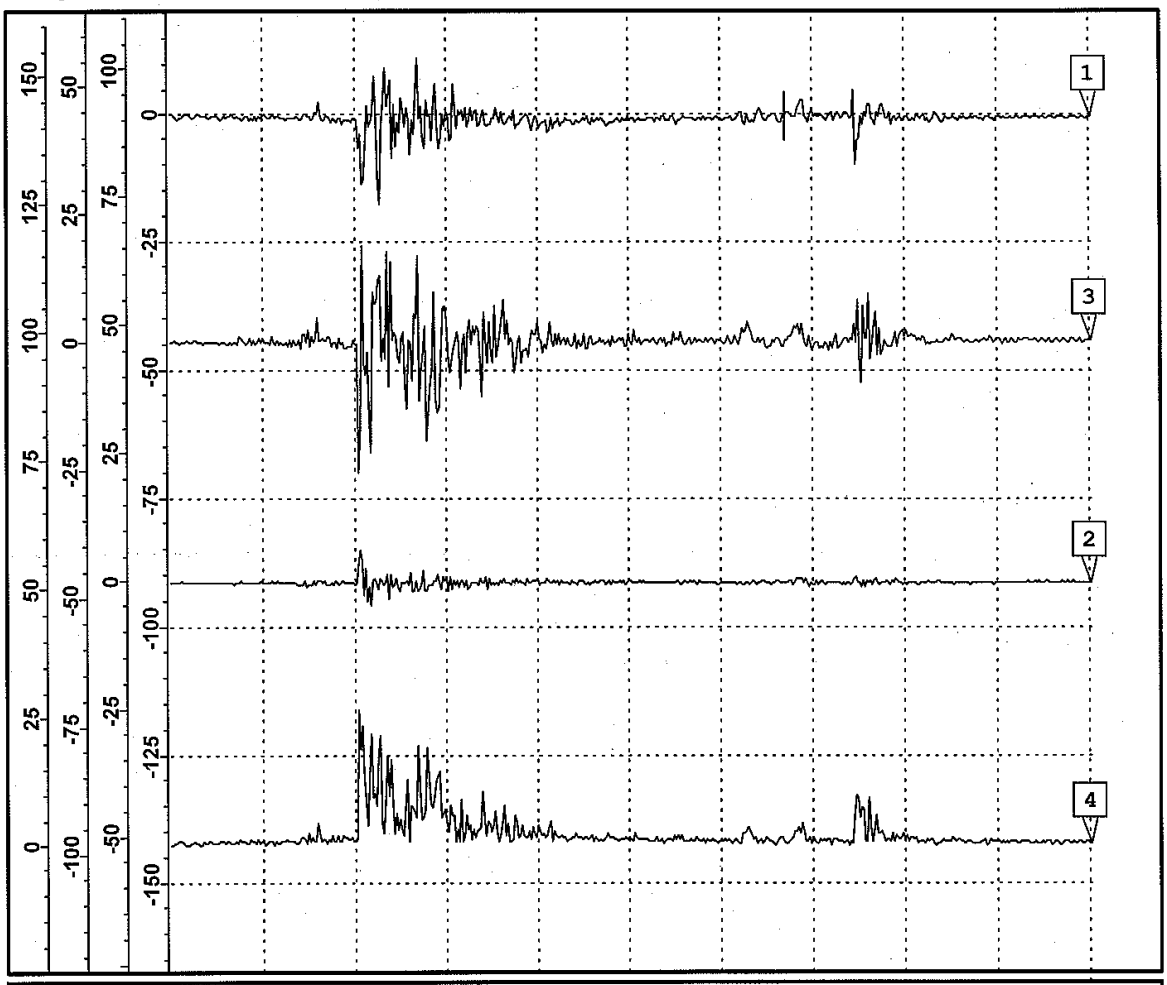
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:56	**Impact Orient.:**	right bottom edge
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 133.15;H.Angle: 90.51;



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
◉	1	875. mS	-0.32 g's	-25.08 g's	-352.97 In/s	131 mS	1	2
○	2	875. mS	-0.00 g's	8.44 g's	46.20 In/s	131 mS	1	2
○	3	875. mS	0.34 g's	52.73 g's	-59.22 In/s	131 mS	1	2
○	R	875. mS	0.47 g's	52.98 g's	360.88 In/s	131 mS	1	2

Remarks

Peak G X: 25 Y: 53 Z: 8 Peak G Resultant: 53
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

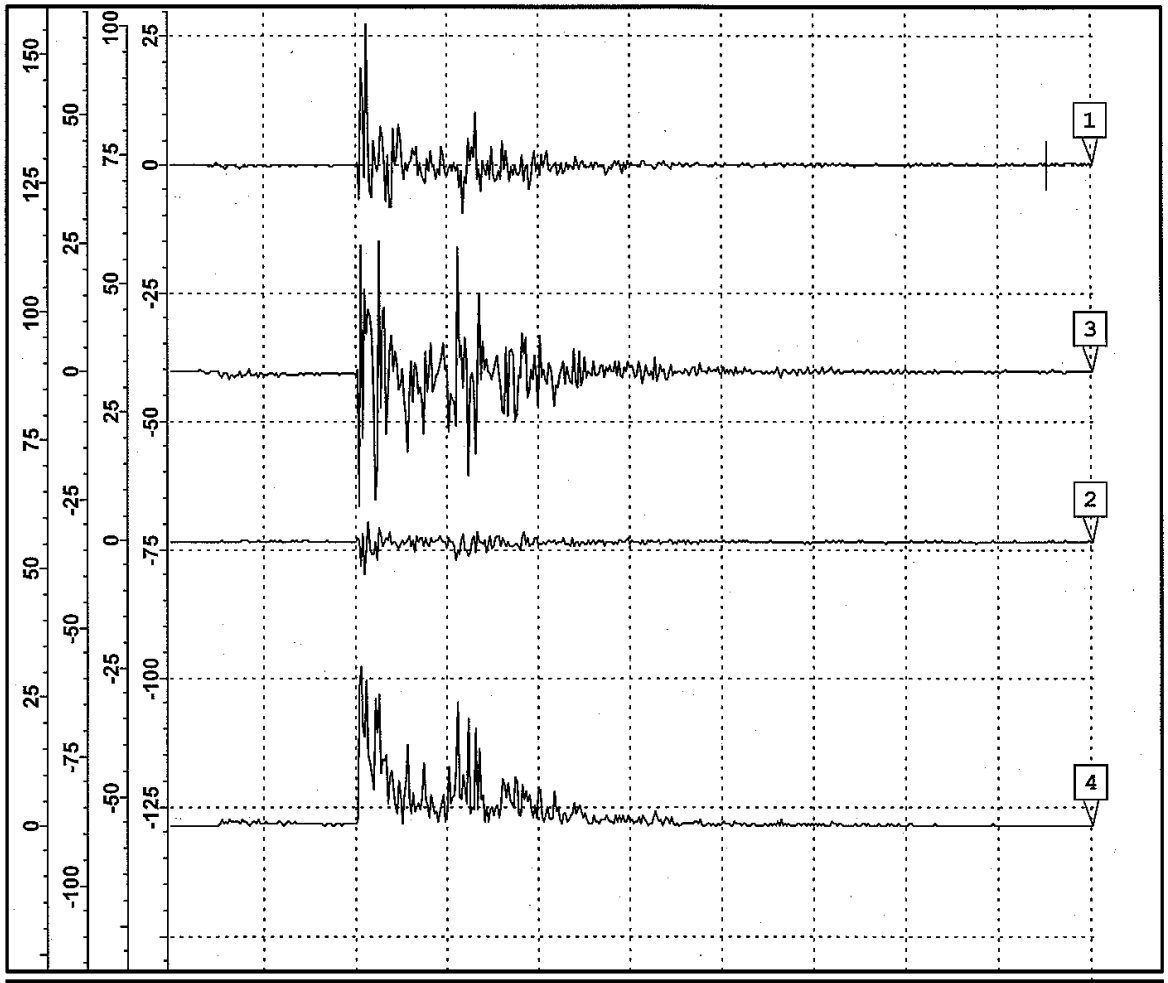
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:49	**Impact Orient.:**	Forward-left corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 78.78;H.Angle: 289.07;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.24 S	0.05 g's	46.00 g's	-17.08 In/s	131 mS	1	2
2	1.24 S	0.09 g's	-6.85 g's	-24.23 In/s	131 mS	1	2
3	1.24 S	-0.25 g's	61.42 g's	-124.25 In/s	131 mS	1	2
R	1.24 S	0.27 g's	61.50 g's	127.74 In/s	131 mS	1	2

Remarks

Peak G X: 46 Y: 7 Z: 61 Peak G Resultant: 62
Item Wt. 153 lb. UNFILTERED.
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

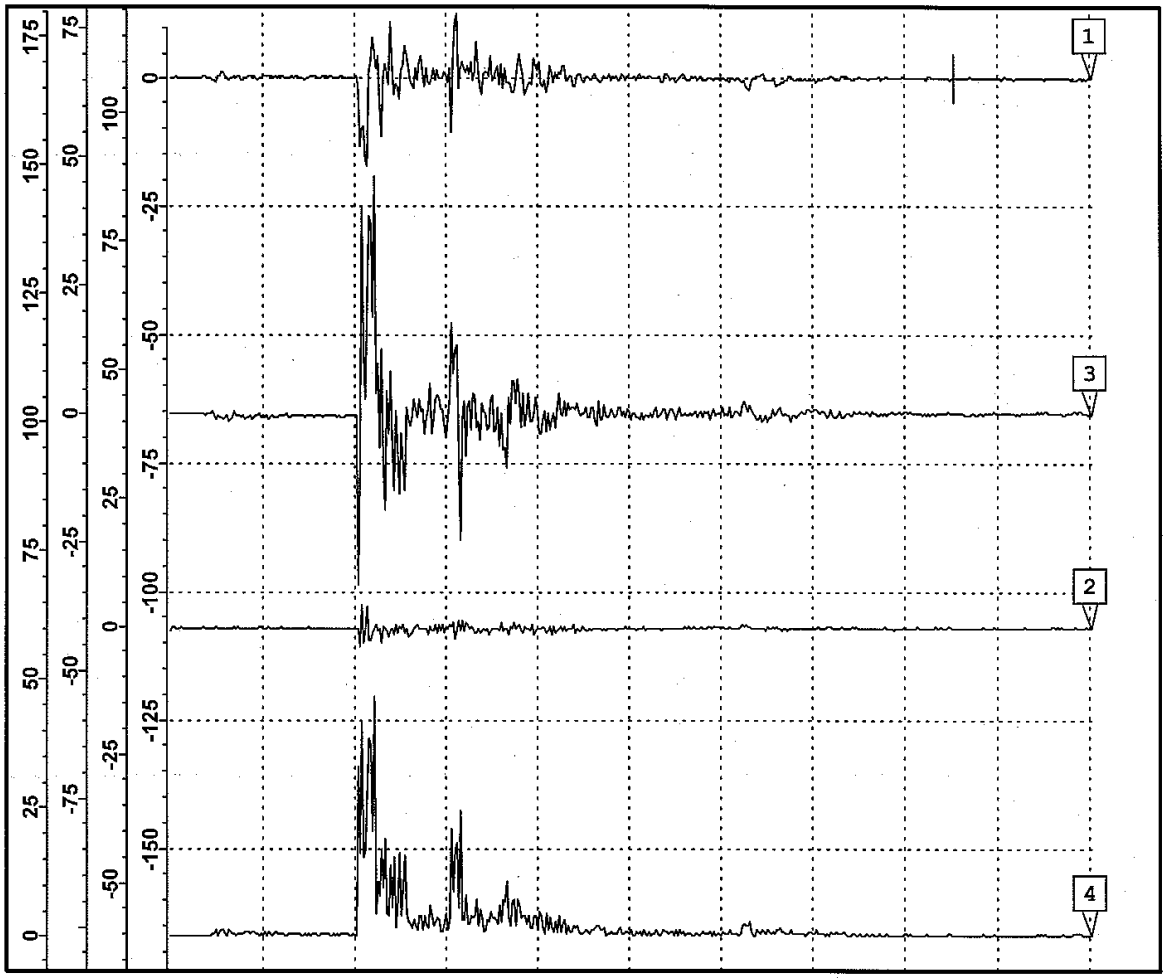
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:46	**Impact Orient.:**	forward-right corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 124.47;H.Angle: 43.36;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	1.11 S	-0.10 g's	-28.67 g's	-11.76 In/s	131 mS	1	2
2	1.11 S	0.11 g's	7.19 g's	-5.36 In/s	131 mS	1	2
3	1.11 S	0.10 g's	70.95 g's	95.95 In/s	131 mS	1	2
R	1.11 S	0.19 g's	71.03 g's	96.81 In/s	131 mS	1	2

Remarks

Peak G X: 29 Y: 71 Z: 7 Peak G Resultant: 71
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

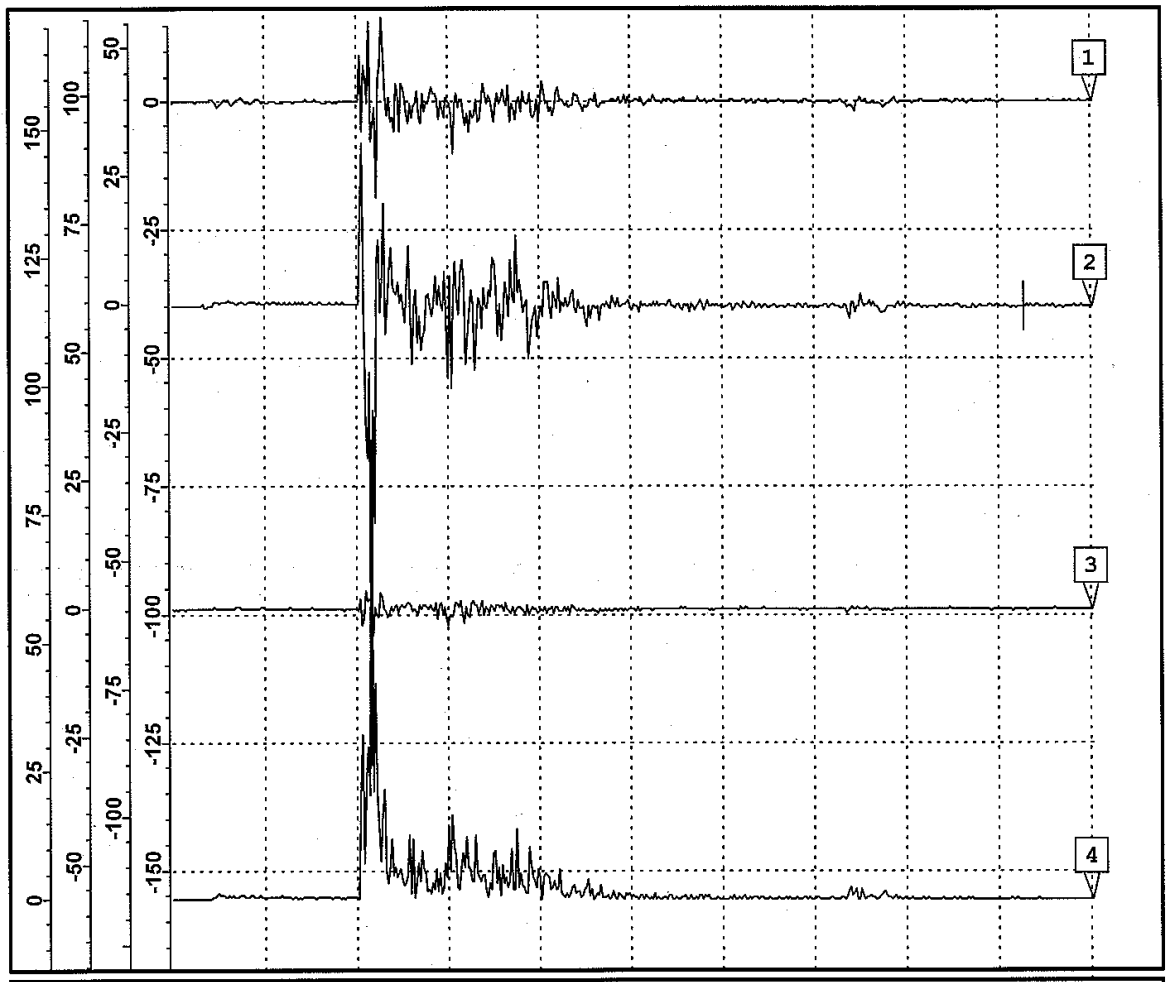
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	Oct 1 2009 15:35	**Impact Orient.:**	aft left corner
Test Engineer:	Evans	**Drop Height:**	12 in.
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 53.75;H.Angle: 183.50;



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	1.21 S	0.11 g's	32.24 g's	-55.28 In/s	131 mS	1	2
◉	2	1.21 S	-0.15 g's	-92.78 g's	-56.59 In/s	131 mS	1	2
○	3	1.21 S	-0.01 g's	-13.39 g's	19.52 In/s	131 mS	1	2
○	R	1.21 S	0.19 g's	93.07 g's	81.48 In/s	131 mS	1	2

Remarks

Peak G X: 32 Y: 93 Z: 13 Peak G Resultant: 93
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); Ch.2=Y(vert); Ch.3=Z(frwd-aft); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

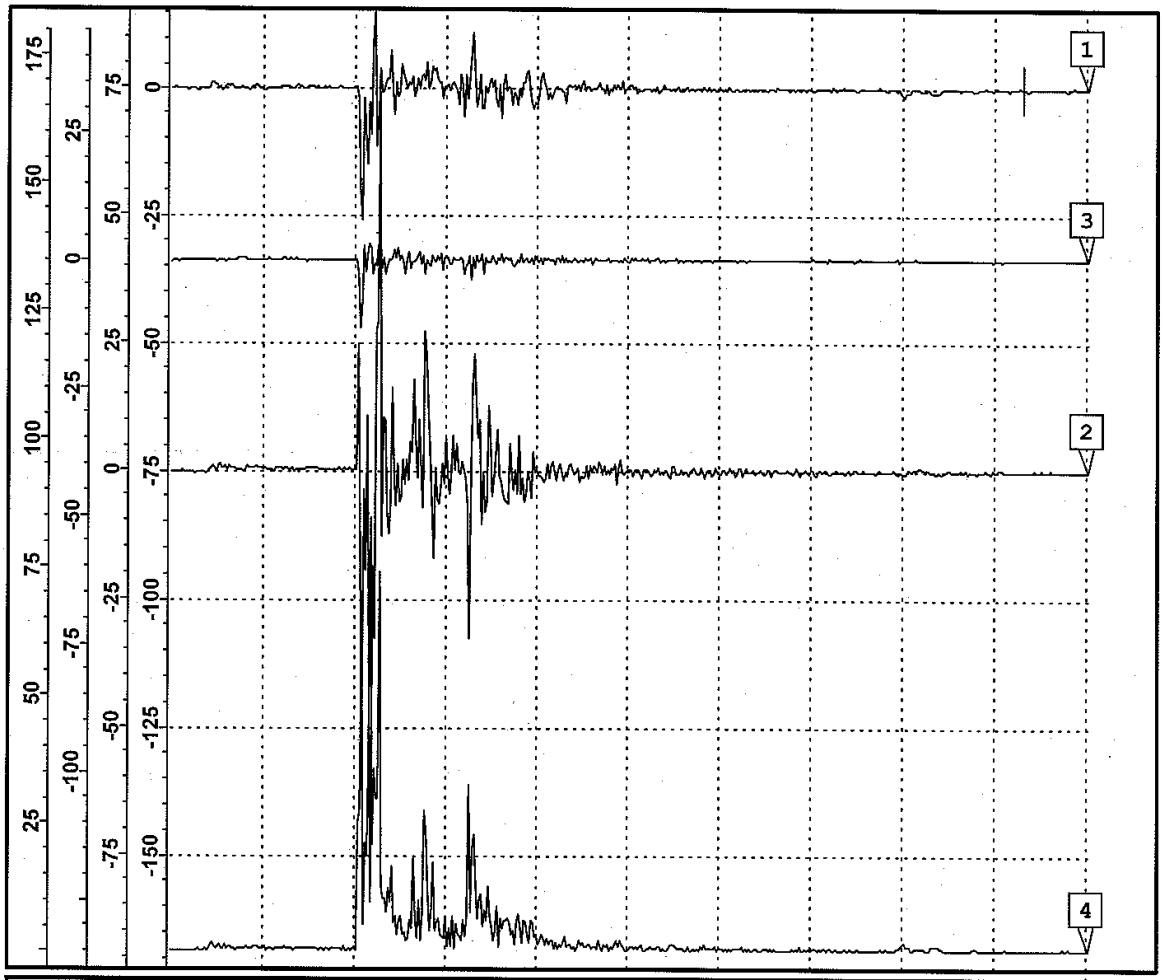
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

ROTATIONAL DROPS

Time:	**Oct 1 2009 15:33**	**Impact Orient.:**	**Aft right corner**
Test Engineer:	**Evans**	**Drop Height:**	**12 in.**
Container:	**Al/probe**	**Accelerometer:**	**2228C, S/N 16471**

V. Angle: 159.31;H.Angle: 76.43;



Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
1	960. mS	-0.24 g's	-32.47 g's	-73.91 In/s	131 mS	1	2
2	960. mS	0.02 g's	-99.49 g's	-23.12 In/s	131 mS	1	2
3	960. mS	0.09 g's	-14.95 g's	21.77 In/s	131 mS	1	2
R	952. mS	0.26 g's	100.34 g's	80.45 In/s	131 mS	1	2

Remarks

Peak G X: 32 Y: 15 Z: 99 Peak G Resultant: 100
UNFILTERED
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads.**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

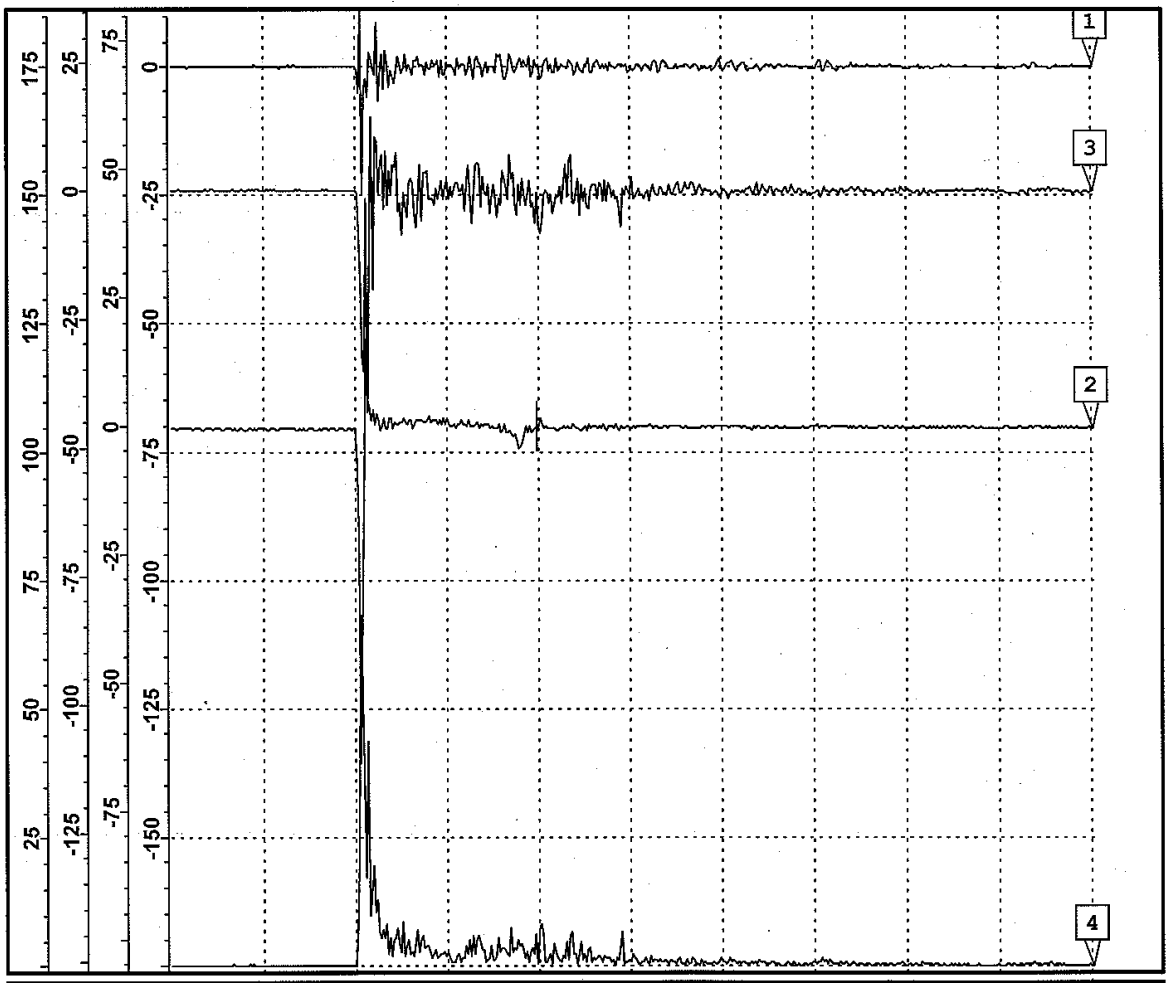
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

PENDULUM IMPACTS

Time:	Oct 1 2009 14:38	**Impact Orient.:**	Forward side
Test Engineer:	Evans	**Velocity:**	7.3 ft/sec
Container:	Al/probe; clamp mod.	**Accelerometer:**	2228C, S/N 16471

V. Angle: 104.81;H.Angle: 319.99;



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	519. mS	-0.18 g's	-30.50 g's	-27.60 In/s	131 mS	1	2
◉	2	519. mS	0.51 g's	-68.04 g's	-63.18 In/s	131 mS	1	2
○	3	519. mS	-0.43 g's	-45.74 g's	-124.17 In/s	131 mS	1	2
○	R	519. mS	0.69 g's	72.95 g's	142.02 In/s	131 mS	1	2

Remarks

Peak G X: 31 Y: 68 Z: 45 Peak G Resultant: 73
Item Wt. 153 lb. UNFILTERED
Ch.1=X(left-rt); *Ch.2=Z(vert); *Ch.3=Y(frwd-aft); Ch. 4=Resultant
***Reversed leads**
Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

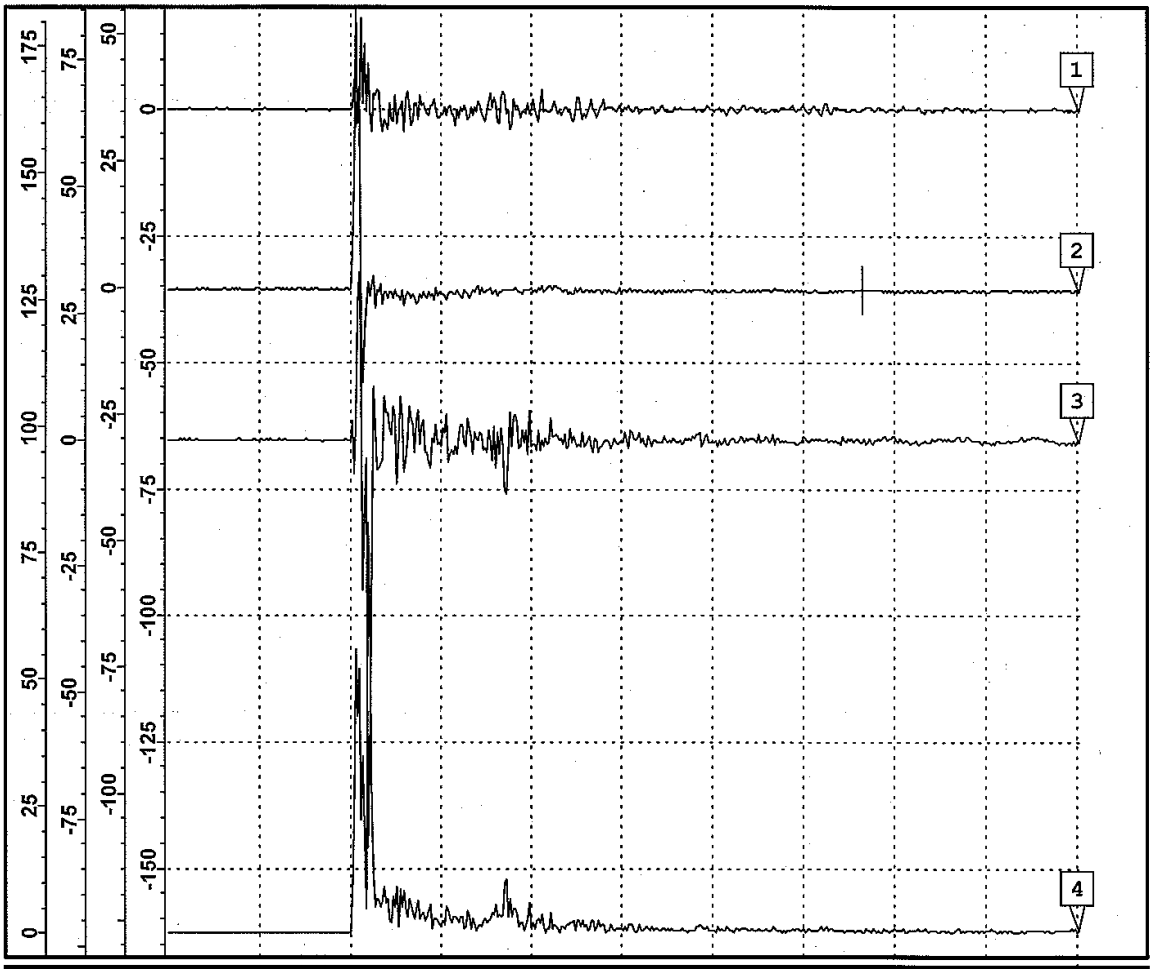
GHI SYSTEMS, INC. CAT SYSTEM

HH60 Fuel Probe

PENDULUM IMPACTS

Time:	Oct 1 2009 14:32	**Impact Orient.:**	aft side
Test Engineer:	Evans	**Velocity:**	7.3 ft/sec
Container:	Al/probe	**Accelerometer:**	2228C, S/N 16471

V. Angle: 124.08;H.Angle: 245.91;



	Ch.	Time	Curr Amp	Peak Amp	1st Int	Time/Div	Hexp	Vexp
○	1	998. mS	-0.19 g's	-32.76 g's	-0.66 In/s	131 mS	1	2
◉	2	998. mS	-0.12 g's	61.31 g's	1.13 In/s	131 mS	1	2
○	3	998. mS	-0.26 g's	-100.60 g's	-127.18 In/s	131 mS	1	2
○	R	998. mS	0.34 g's	103.42 g's	127.19 In/s	131 mS	1	2

Remarks

Peak G X: 33 Y: 61 Z: 101 Peak G Resultant: 103
UNFILTERED
Ch.1=X(left-rt); Ch.2=Y(frwd-aft); Ch.3=Z(vert); Ch. 4=Resultant

Aft side = desiccant port end. Ambient temperature/humidity
ASTM D4169, ASTM D6179. SAE ARP 1967.

GHI SYSTEMS, INC. CAT SYSTEM

APPENDIX 4: Test Instrumentation

PRESSURE TEST EQUIPMENT - Test sequences 1, 2, 6 & 7

EQUIPMENT	MANUFACTURER	MODEL	SN	CAL. DATE
Digital Manometer	Yokogawa	2655	82DJ6001	Sep 09
Digital Manometer	Yokogawa	2655	82DJ6009	Jul 09

ROUGH HANDLING TEST EQUIPMENT - Test sequences 3, 4, & 5

EQUIPMENT	MANUFACTURER	MODEL	SN	CAL. DATE
Shock Amplifier	Endevco	2775A	ER34	NA
Shock Amplifier	Endevco	2775A	ER33	NA
Shock Amplifier	Endevco	2775A	EL81	NA
Item Accelerometer	Endevco	2228C	16471	Jun 08
Data Acquisition	GHI Systems	CAT	Ver. 2.7.1	N/A

APPENDIX 5: Distribution List

DISTRIBUTION LIST

DTIC/O
DEFENSE TECHNICAL INFORMATION CENTER
FORT BELVOIR VA 22060-6218

411 SCMS/GULD
ATTN STANLEY COLLINS
235 BYRON STREET STE 19A
ROBINS AFB, GA 31098

403 SCMS/CL
5215 THURLOW ST, STE 5
BLDG 70C
WRIGHT-PATTERSON AFB OH 45433-5547

418 SCMS/GULAAA
ATTN THELMA LOOCK
7973 UTILITY DR
BLDG 1135
HILL AFB UT 84056

420 SCMS/GUMAA
ATTN CAROL BAXTER
7701 ARNOLD ST
BLDG 1, RM 112
TINKER AFB OK 73145

406 SCMS/GUMA
ATTN WAYNE OSBORN
375 PERRY ST
BLDG 255
ROBINS AFB GA 31098

APPENDIX 6: Report Documentation

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
23-11-2009	Technical Final Project Report	May 2009 to November 2009

4. TITLE AND SUBTITLE
Development of the HH-60 Fuel Probe Container

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER
09-P-107

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Packaging Technology & Engineering Facility
403 SCMS/GUEB
5215 Thurlow St, Ste. 5
Wright-Patterson AFB, OH 45433-5547

8. PERFORMING ORGANIZATION REPORT NUMBER
09-R-04

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
411 SCMS/GULD
235 BYRON STREET STE 19A
ROBINS AFB, GA 31098

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSORING/MONITORING AGENCY REPORT NUMBER

12. DISTRIBUTION AVAILABILITY STATEMENT
Approved for Public Release
Distribution Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The Air Force Packaging Technology Engineering Facility (AFPTEF) was tasked with the design of a new shipping and storage container for the HH-60 Fuel Probe in April of 2009. The current wood container is difficult to handle, falls apart easily, provides minimal physical protection of the item, and offers no environmental protection against corrosion. To solve these issues AFPTEF used proven design techniques IAW SAE ARP1967A to develop an aluminum, long-life, controlled breathing, reusable shipping and storage container which will protect the fuel probe both mechanically and environmentally. The container passed all qualification tests per SAE ARP1967A, ASTM D4169, and MIL-STD-648. This container not only meets user requirements but will also provide a significant economic savings, per refueling probe, for the Air Force over the twenty-year life span of the container.

15. SUBJECT TERMS
HH-60, Refueling probe, container, aluminum container, reusable container, design, test, long-life, controlled breathing, shipping, storage

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Michael R. Harff
U	U	U	UU	49	**19b. TELEPONE NUMBER (*Include area code)*** (937)257-4519